Chapter Two: Contents

(Population Synthesizer – LA-UR 00-1725)

Disclaimer

These archived, draft documents describe TRANSIMS, Version 1.1, covered by the university research license. However, note that the documentation may be incomplete in some areas because of the ongoing TRANSIMS development. More recent documentation (for example, Version 2.0) may provide additional updated descriptions for Version 1.1, but also covers code changes beyond Version 1.1.

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Chapter Two—Population Synthesizer

1. INTRODUCTION

1.1 Overview

Because TRANSIMS is based on the movement of individual travelers between activities at different locations, it must create a synthetic population that represents every individual in the metropolitan region under study. Population demographics are crucial in creating reality-based simulations because such demographics determine the level of activity for each household.

Demographic examples include the individual's age, income, gender, and employment status. Such demographics determine how each individual travels across the transportation network. For example, a six-year-old girl will take the bus to school, whereas a 30-year-old executive will carpool to work.

The procedures outlined in this chapter generate a baseline 1990 synthetic population and provide methods that can update this population to a future year. At this time, the update methodology requires forecast demographics in the exact format as used by Portland Metro. This will change in future releases of this technology.

1.2 Source Data

To create a virtual population, the Population Synthesizer requires the following types of source data:

- U.S. Census Bureau Summary Tape File 3A (STF-3A) data[1],
- U.S. Census Bureau Public Use Microdata Samples (PUMS) [2]
- Master Area Block Level Equivalency/Geographic Correspondence Engine (MABLE/Geocorr), and
- Forecast marginal demographic data.

1.2.1 STF-3A Data

These files contain demographic summary tables from the 1990 Census for small geographic areas, census tracts, or census block groups. Mostly one-dimensional, these summary tables contain information such as the distribution of the age of the householder or the number of workers in the family. Table 1 and Table 2 show typical STF-3A data.

[1] Census (1992a) *Census of Population and Housing, 1990*, Summary Tape File 3 on CD-ROM Technical Documentation/prepared by the Bureau of Census. The Bureau, Washington.
[2] Census (1992b) *Census of Population and Housing, 1990*; Public Use Microdata Sample U.S. Technical Documentation/prepared by the Bureau of Census. The Bureau, Washington.

Table 1. Number of workers in family households for census tract 1, block group 2 of Los Alamos County, NM.

	Number of Family Households, *n*, with Number of Workers in Household			
Workers	0	1	2	>2
n	0	121	214	25

Table 2. Age distribution of householders for census tract 1, block group 2 of Los Alamos County, NM.

	Number of Family Households, *n*, with Householder Age in the Given Ranges						
Age	15-24	25-34	35-44	45-54	55-64	65-74	>74
n	4	134	94	46	46	36	0

1.2.2 *PUMS*

Census tracts or block groups that are combined into much larger geographic areas are known as Public Use Microdata Areas, or PUMA. Microdata in each PUMA, the PUMS, consists of a 5% sample of the complete census records for the PUMA. PUMS contain the complete structure of each household, including the number of people in a given household, the household income, number of workers, and number of vehicles owned. These files are edited to protect the confidentiality of all individuals, but they have the information necessary to conduct effective research and analysis.

1.2.3 MABLE/Geocorr

The MABLE/Geocorr search engine supports data maintained by the Center for International Earth Science Information Network (CIESIN) at Columbia University. The data and search engine are available at the following Internet site:

http://plue.sedac.ciesin.org/plue/geocorr

The combined data set and the search engine yield a correspondence between PUMAs and census block groups

1.2.4 Forecast Marginal File

When creating a forecast population, the Population Synthesizer requires a “Forecast Marginal File” as input. This file contains the forecast marginal distributions, like those given above in Table 1, for household size, householder age, and household income as a function of census tract and block group.

This file must be created outside the TRANSIMS Framework; forecasts can typically be obtained by transportation planning agencies.

1.3 Using the Data

TRANSIMS uses an algorithm developed by Beckman, Baggerly, and McKay[3] to generate synthetic populations from the four data sets described above. Land-use data are used to place individual households at activity locations along the transportation network. A complete description of the algorithm appears in section 4.0 Algorithm.

[3] Beckman, Richard J., Baggerly, Keith A., and McKay, Michael D. (1996), Creating Synthetic Baseline Populations, *Transportation Research* A, Vol 30, No. 6, pp 415-429.

2. MODULE DESCRIPTION

2.1 Overview

Fig. 1 shows the types of data the Population Synthesizer uses to generate a synthetic population of households that contain individual demographics and household locations within the TRANSIMS Network.

2.2 Defining a Household

In the baseline methodology presented here, each household in a synthetic population is classified as either family, non-family, or individuals living in group quarters such as dorms. At a minimum, each household must contain at least one person; family households contain one or more adults and possibly children. Household demographics vary in accordance with source data and study needs.

2.2.1 Using Households

TRANSIMS assigns households to activity locations on a link of the TRANSIMS Network. Each activity location is assigned to a link on the network and is associated with the land-use characteristics that surround it. Multiple households can be assigned to one activity location.

Example**:**

> An activity location on a link can represent one side of a street, whereas a second could represent activities taking place on the other side. Moreover, activity locations could represent individual buildings on a street, or one activity location could represent all activities that take place on the street.

Synthetic populations in essence “drive” the Activity Generator, which uses the data to create individual travel activities, such as work, school, or a shopping. Population data also can be used to categorize and filter population subsets used for various types of equity analyses.

2.3 Data Format

Any viable source of household and demographic data can be used to construct a synthetic population, provided that the output of the computation is formatted in accordance with TRANSIMS data formats for synthetic populations.

The TRANSIMS team has developed and released a separate software packaged known as *TRANSIMS, Population Synthesizer*. This package enables users to experiment with and build synthetic populations by manipulating census data.

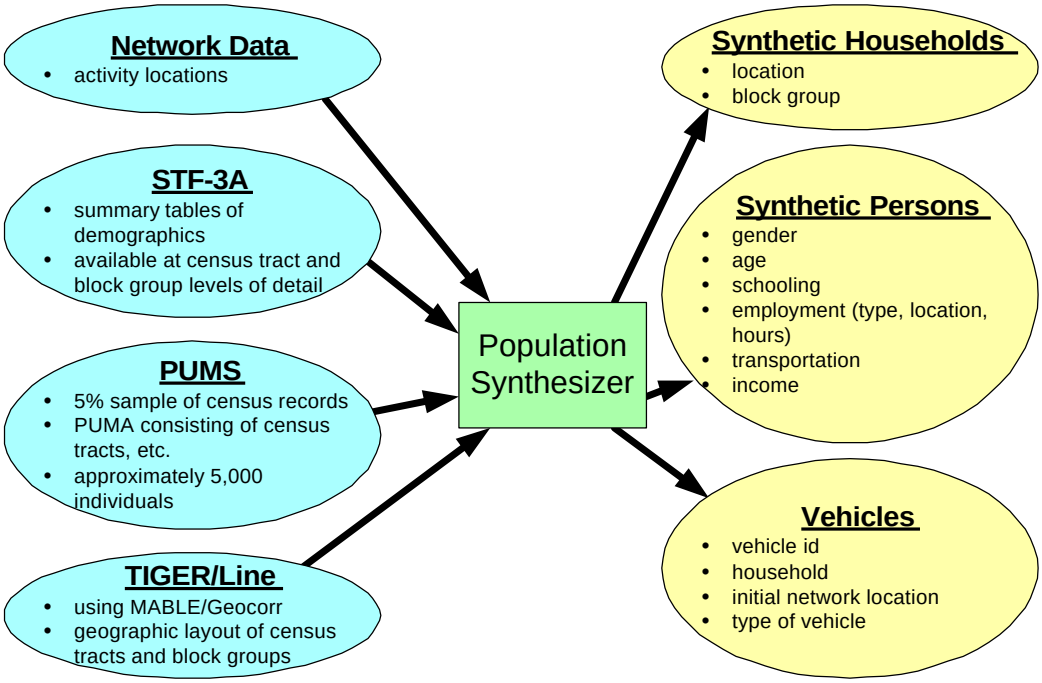

Fig. 1. The Population Synthesizer takes in various types of census data to generate synthetic households, individuals, and vehicles.

3. GENERATING A SYNTHETIC POPULATION

Step One

- Identify an appropriate PUMA.
- Use MABLE/Geocorr to obtain a list of block groups within the PUMA.

Step Two Obtain summary statistics from STF-3A for each of the block groups identified in the PUMA.

Example:
Summary data could include the householder's age, the family's income, type of family (single parent, divorced, etc.), and number of workers in the household.

Step Three

- Construct a multidimensional table from the PUMS data.
- Make sure that the dimensions correspond with STF-3A summary statistics.

Note: Fig. 2 represents these steps in graphic form.

Example:
In the example above, the multidimensional table would have four dimensions that correspond to four classifications: householder's age, the family's income, type of family, and number of workers in the household.

- Each household in the PUMS has a household weight. The sum of these weights for each of the households in the PUMS for each classification compose the multidimensional table.

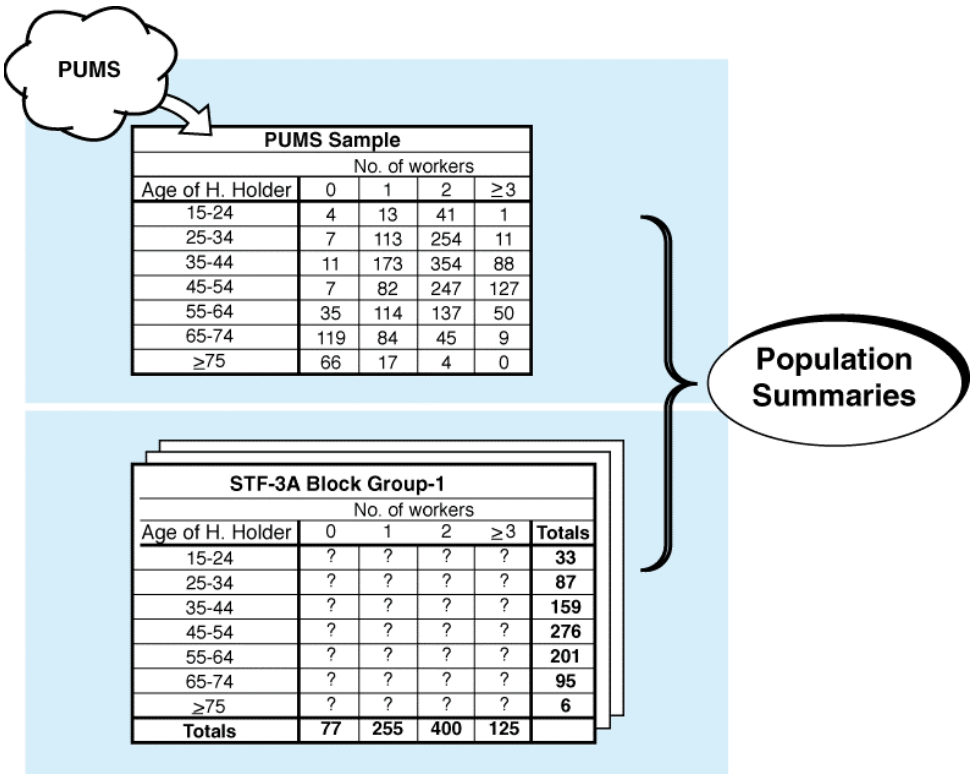

Fig. 2. TRANSIMS uses various data types to generate a synthetic population. Note that these data have been modified to ensure anonymity.

Step Four

- At this point, the proportion of households for each block group's classification is unknown. To determine this, TRANSIMS uses a two-stage iterative proportional fitting procedure outlined by Beckman, Baggerly, and McKay[4].
- This procedure satisfies the distributions of the STF-3A data for each block group while maintaining the correlation structure of the table constructed from the PUMS.

Step Five

- The block groups are updated for a forecast.
- Iterative proportional fitting uses the correlation structure of the generated block group demographic tables and the STF-3A type forecast demographics for the update.

Step Six

- Select households from the PUMS to match the number of households in the Census over a given geographic area, such as a block group or a census tract.
- Use land-use information to place each household within a block

[4] See Footnote 3.

group at an activity location.

Note: A baseline population for the census year can be generated by skipping Step Five.

Note: Land-use data are stored in the network activity location files. At a minimum, these files contain the identity of the activity locations, their locations, the corresponding block group and census tract, and some indication of the activities that may be performed at that location.

Fig. 3 shows this step graphically.

- Identify the activity locations within a block group before placing households from the synthetic population at an activity location.

- Using land-use data, determine a weight for each activity location. These weights are proportional to the probability that a household will be placed at the activity location. The weights could be formed, for example, by adding the single family residential square footage to the multiple of the multifamily square footage for each activity location. In another approach, the number of households on a block could be determined from phone books and used as the weights.

- Divide each individual weight for an activity by the total weight of all the activity locations in the block group.

- The resultant ratios are used as the probability of a household being located on a link.

- For each synthetic household, a random activity location (based on the probabilities) is selected; the household then is placed at that activity location.

  Note: Households need not be placed at unique activity locations. Many households can share the same activity location.

- The household location algorithm can remain the same no matter which area is being studied. However, the weights given to the activity locations in a block group will depend on the quality and availability of land-use data.

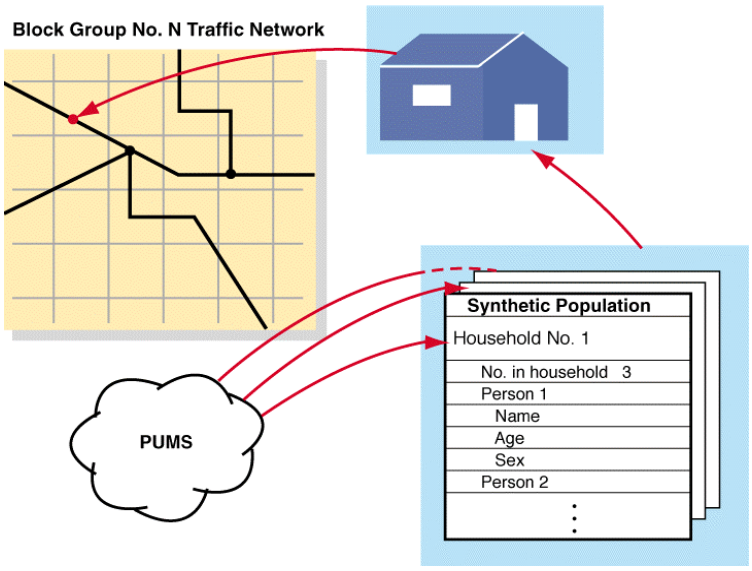

Fig. 3. Creating households and placing them on the network involves randomly selecting actual PUMS households in accordance with the proportions derived from the Iterated Proportional Fitting method.

3.1 Other Techniques

Households may be located on a link by other techniques.

Example 1:

A census block could be used to determine the number of households in a block. This number then could be associated with an activity location and used as the weight.

Example 2:

Electronic phone books or aerial photography could be used to determine the number of households in a block.

Note: To date, neither of these techniques has been used during a TRANSIMS case study.

3.2 What About Vehicle Ownership?

To assign vehicle ownership, TRANSIMS currently uses the number generated from the synthetic population procedure using the PUMS or just assigns every possible driver a vehicle. A more refined vehicle ownership model based on population demographics and network characteristics could be implemented and called in the Framework after the synthetic population has been generated.

In traditional methods, household vehicle ownership has been a factor in the choice of transportation modes. Given the TRANSIMS iterative methods to determine the traveler's mode of transportation using the iteration database and the Selector, a refined vehicle ownership model is not necessary.

In either case, each vehicle represents an entry in a vehicle file. This file contains the TRANSIMS vehicle identification number, the household to which it is assigned, and the vehicle emissions type. The emissions type is used in the Emissions Estimator module to determine emissions. It reflects the operating condition of the vehicle, its type, and age.

Presently, these vehicle types are assigned at random according to a national or local distribution of 23 vehicle emission types described in Volume Three (*Modules*), Chapter Seven (*Emissions Estimator*). In the future, an analyst may wish to use a vehicle type model based on Department of Motor Vehicle statistics, inspection and maintenance records, and the synthetic population.

3.3 Further Reading

A paper by Beckman, Baggerly, and McKay[5] outlines how to generate a synthetic population. The technique described in this paper applies 1990 census data given in STF-3A and PUMS.

[5] See Footnote 3.

4. ALGORITHM

4.1 Overview

Fig. 4 shows the data flow used to create, locate, and assign vehicles to a complete synthetic population of households and individuals.

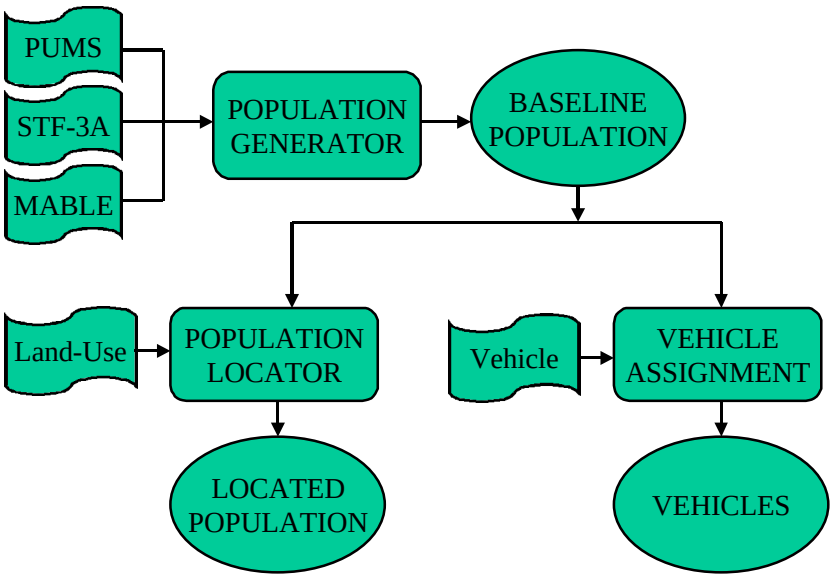

Fig. 4. This flowchart shows the process used to create, locate, and assign vehicles to a complete synthetic population and individuals.

4.2 Baseline Population Synthesizer

Of the processes shown in Fig. 4, the baseline Population Synthesizer is the most complex. Its objective is to create a population over small geographic areas of census groups that maintain the statistical characteristics of the census. However, as shown in Table 3, the summary data for block groups from STF-3A do not give the entries for any cross-classified demographics.

Table 3. The cross-classification of the number of workers and the age of the householder for census tract 1, block group 2 of Los Alamos County, NM, is unknown.

	Householder Age							
Workers	15-24	25-34	35-44	45-54	55-64	65-74	>74	Total
0	?	?	?	?	?	?	?	0
1	?	?	?	?	?	?	?	121
2	?	?	?	?	?	?	?	214
>2	?	?	?	?	?	?	?	25
Total	44	134	94	46	46	36	0	

A synthetic population is easily generated if cross-classified tables exist for small areas such as block groups. Because PUMS contains complete household records, these could be drawn at random, thus satisfying the cross-classified table for the block group. This is the general scheme for the algorithm presented in this document, except that the cross-classified table for the block groups is estimated. This estimation process satisfies the totals as given by STF-3A.

The general methodology consists of three steps.

Step One Select a reasonable set of demographics from STF-3A that characterize the population.

Step Two For each block group, estimate the proportions in the cross-classified table made up of the demographics selected in Step One

Step Three Draw households at random from the PUMS corresponding to the block group so that the estimated proportions in the cross-classified table are satisfied.

4.3 Multiway Summary Tables

Although cross-classified tables cannot be derived from STF-3A for small areas, multiway summary tables can be created for the entire PUMA area. For example, block group 2 of census tract 1 for Los Alamos County, NM, is contained in PUMA 00400. Table 4 provides the multiway table for this PUMA. It shows the number of workers in a family and the age of the householder.

Table 4. The cross-classification of the number of workers and the age of the householder for PUMA 00400, which contains census tract 1, block group 2 of Los Alamos County, NM.

	Householder Age							
Workers	15-24	25-34	35-44	45-54	55-64	65-74	>74	Total
0	2	11	9	3	26	64	42	157
1	11	108	122	48	80	61	18	448
2	28	135	274	156	85	22	6	706
>2	0	3	65	76	40	10	3	197
Total	41	257	470	283	231	157	69	

To estimate the proportions in the cells of the multiway block group tables, TRANSIMS uses iterative proportional fitting[6] (IPF) of the block group summaries to the cross-classified values in the PUMS. IPF ensures that the correlation structure of the demographics for every entity that contributes to the PUMA (e.g., block groups) is the same as the correlation structure in the multiway tables constructed from the PUMS.

IPF assumes that we have (1) a sample from a multiway classification of characteristics, and (2) the exact totals for the margins of the multiway table. In this case, we could assume that the PUMS represents the sample and the STF-3A data give the marginal totals. We show later that this is an oversimplified view of these data, but we continue with this to better explain IPF.

IPF estimates (i.e., refines) the entries in the sample multiway table (in this instance, the PUMS) to make them exactly match the known marginals (in this case, the STF-3A summary data) while maintaining the sample table's correlation structure. The algorithm is exceedingly simple. The algorithm begins by converting all summaries and tables to proportions of the total. For example, Table 3 and Table 4 become Table 5 and Table 6, respectively. In terms of proportions, the PUMS sample for these two demographics is shown in Table 7.

IPF converts the PUMS proportions in Table 7 so that they have the same row and column proportions as the STF-3A data given in Table 5 and Table 6. IPF accomplishes this by first changing the rows then the columns according to the following rules:

- Update the first row of Table 7 by multiplying each entry by the first marginal proportion for that row given in Table 5 and dividing by the total for that row on the last iteration. In this case, the first element of the first row of Table 7 becomes 0.001*0.000/0.104=0.000.
- This process continues with the remainder of the rows of Table 7, where (for example) the third entry of the second row becomes 0.081*0.336/0.297=0.092.

After all the rows are updated, the same procedure is applied to each column. The procedure continues by alternating between rows and columns until the table entries no

[6] Deming, W.E. and Stephan, F.F. (1940), On A Least Squares Adjustment Of A Sampled Frequency Table When The Expected Marginal Tables Are Known, *Annals of Mathematical Statistics*, Vol. 11, pp 427-444.

longer change. For tables with more than two dimensions, the same procedure is followed—updating one dimension at a time. Table 8 shows the final results of this procedure, based on the data in Table 7.

If required, the forecast procedure updates these tables. In either case, the last step in household generation is to draw samples from the PUMS. There are 360 family households in the block group given below. For this block group, 360 households are generated—one at a time—following this procedure:

- First, a category of age and the number of workers are selected at random according to the probabilities in Table 8.
- And second, given the category (e.g., a householder between 45 and 54 years of age in a household with two workers), one of the households in the PUMS matching these demographics is drawn at random. In this case, one household would be drawn from the 156 households possible (as shown in Table 4).

This process is repeated 360 times to form a population that matches the census. Note that the same household from the PUMS may be selected multiple times by this procedure.

Table 5. Proportion of workers in family households for census tract 1, block 2 of Los Alamos County, NM.

Proportion of Family Households, *n*, with Number of Workers in the Household				
Workers	0	1	2	>2
Prop.	0.000	0.336	0.594	0.069

Table 6. Proportion of ages of householders for census tract 1, block group 2, of Los Alamos County, NM.

Proportion of Family Households, *n*, with Householder Age in the Given Ranges							
Age	15-24	25-34	35-44	45-54	55-64	65-74	>74
Prop.	0.011	0.372	0.261	0.128	0.128	0.100	0.000

Table 7. Cross-classification of the proportion of workers and the age of the householder for PUMA 00400, which contains census tract 1, block group 2 of Los Alamos County, NM.

	Householder Age							
Workers	15-24	25-34	35-44	45-54	55-64	65-74	>74	Total
0	0.001	0.007	0.006	0.002	0.017	0.042	0.028	0.104
1	0.077	0.072	0.081	0.032	0.053	0.040	0.012	0.297
2	0.019	0.090	0.182	0.103	0.056	0.015	0.004	0.468
>2	0.000	0.002	0.043	0.050	0.027	0.007	0.002	0.131
Total	0.027	0.170	0.312	0.188	0.153	0.104	0.046	

Table 8. Estimated cross-classification of the proportion of workers and the age of the householder for families in census tract 1, block group 2 of Los Alamos County, NM.

	Householder Age							
Workers	15-24	25-34	35-44	45-54	55-64	65-74	>74	Total
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
1	0.003	0.141	0.061	0.020	0.047	0.063	0.000	0.336
2	0.009	0.228	0.178	0.086	0.065	0.030	0.000	0.594
>2	0.000	0.003	0.022	0.022	0.016	0.007	0.000	0.069
Total	0.011	0.372	0.261	0.128	0.128	0.100	0.000	

Tables 1, 3, and 4, as well as the paper by Beckman, Baggerly, and McKay[7], show that fitting only one block group at a time using IPF is not entirely correct. IPF is based on the assumption that the seed proportions (as given by the PUMS, Table 7) are a sample of the population that produces the exact marginal totals given by STF-3A (shown here in Table 7). Table 1 shows there are no households with 0 workers in the block group, while Table 4 shows many 0-worker households.

The PUMS consists of a sample of households that contain all or parts of multiple block groups. In this case, block group 2 of census tract 1 from Los Alamos County is just one of the many block groups in PUMA 00400. PUMA 00400 contains all of the block groups in Los Alamos and Santa Fe counties of New Mexico. That PUMA 00400 is a sample of multiple block groups is evident from PUMS.

4.4 Creating the Population

TRANSIMS uses the following steps to construct a true synthetic population. A two-step procedure is used to modify the IPF routine so that it can simultaneously consider all block groups that make up a PUMA. A final step is added to take into account the forecast marginal inputs.

Step One Assemble each block group in a PUMA from the MABLE/Geocorr database. In a small percentage of cases, a block group is split between multiple PUMAs. In such cases, the summary totals are reduced by the proportion of the block group's households in the PUMA. This information is also available from the MABLE/Geocorr database.

Step Two Collect the marginal STF-3A tables for the block groups in the PUMA.

Step Three Construct from the PUMS a multiway demographic table that matches the demographics from the STF-3A tables for the corresponding PUMA. The entries of this table are the sums of the household weights from the PUMS.

[7] See Footnote 3.

Step Four

- Add the marginal tables for all the block groups in the PUMA.
- Estimate a multiway table for the entire PUMA by using an IPF fit of this summed table to the PUMS.

Step Five

- Use the estimate table as an additional marginal table.
- Create an (*m+1*)-dimensional table.

The first *m* dimensions are the *m* marginals from STF-3A, whereas the $m+1^{st}$ marginal is created by *stacking* all of the marginal tables. This (*m+1*)-dimensional stacked table, along with the table estimated from the sums, are the marginal tables used in an IPF procedure to an (*m+1*)-dimensional table consisting entirely of ones. This results in an estimated multiway table for each block group in the PUMA. More information on this process can be found in the paper by Beckman, Baggerly, and McKay[8].

In a forecast setting, Step Six is executed. Otherwise, it is skipped.

Step Six

- Combine the block group estimates from the step above to form one multidimensional array.
- Using iterative proportional fitting, fit sets of forecast marginals against the multidimensional array—one block group at a time.

Forecasted populations for TRANSIMS are generated using a modification of the procedures given in the paper by Beckman, Baggerly, and McKay[9]. The technology's user must supply the algorithm with the STF-3A and PUMS data for the base year as required by Beckman, Baggerly, and McKay, which is shown in the five steps above. Additionally, the user must supply a set of summary demographics, such as age of the householder and household income, for the households in each block group in the projected year.

To forecast a population given projected STF-3A type marginal data on a census block group basis for the entire region, one starts with an individual PUMA. At the end of Step Five, three multidimensional arrays have been estimated for each census block group in the PUMA. The dimensions of the three tables or arrays (one for family households, one for non-family households, and one for those living in group quarters) represent particular demographic types. The entries in the arrays are the proportions of households of the various demographic types generated in the complete baseline procedure.

[8] See Footnote 3.
[9] See Footnote 3.

For family households the array has five demographic dimensions:

- the householder's age,
- the family income,
- the number of workers in the family,
- the type of family, and
- the householder's race.

The non-family array or table is also indexed by five demographic variables. These are as follows:

- the household type;
- the race of the householder,
- the age of the householder
- the gender of the householder; and
- the household income.

Group quarters arrays are two dimensional and represent:

- the type of group quarters, and
- the age of the individuals.

In general, let the proportions in the arrays or tables be denoted by the following:

- ${}^{f}p_{i,j,k,l,m}$ for a family array
- ${}^{n}p_{i,j,k,l,m}$ for a non-family array
- ${}^{g}p_{i,j}$ for group quarters

The forecast procedure proceeds as follows. The block groups in the PUMA that have the maximum number non-zeros in the estimated proportion arrays are identified. Of these, the block group with the largest number of households is selected. For this block group, the proportions of family households, non-family households, and group quarter residents are denoted by w^f, w^n and w^g, respectively. In the second step, an array, H, with dimensions equal to the number of forecast demographics, is created. In Portland, these demographics are the size of the household, the age of the householder, and the household income. Without loss of generality, we consider only these three demographics here. That is, we compute the array $H_{P,A,I}$.

$H_{P,A,I}$ is computed in the following steps. For each sample in the PUMS:

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[10] See Footnote 3.
[11] See Footnote 3.

1. Determine if the house is a family, non-family, or a group quarter resident. Here, we assume the household under question is a family household.

2. For this family household, ascertain the five demographic indexes. Assume that these are 1,3,2,4,5.

3. Determine the indexes for the forecast demographics *P,A,I*. Assume here that these are *p,a,i*.

4. Let *WT* be the household weight given in the PUMS.

5. Update the array value $H_{p,a,i}$ as follows:
$H_{p,a,i} = H_{p,a,i} + w^f \cdot {}^f p_{1,3,2,4,5} \cdot WT$.

To compute a set of cross-classified proportions for each block group in the PUMA, we use the array $H_{P,A,I}$ and iterative proportional fitting as described by Beckman, Baggerly, and McKay[10]. The forecast marginal demographics, household size, age of the householder, and household income for Portland are fit against the array $H_{P,A,I}$ using iterative proportional fitting. The result is a three-dimensional array of proportions for the block group. The final set in the procedure is to select households from the PUMS according to these proportions as described in the Beckman, Baggerly, and McKay[11] paper.

In cases in which the cross-classified forecast proportions of the demographics rather than the marginal distributions are given, the households are drawn directly from the PUMS according to these proportions. The array $H_{P,A,I}$ and the corresponding iterative proportional fit are not computed.

Step Seven Draw random households from the PUMS that match the demographics of each of the cells of the estimated multiway table for each block group.

4.5 Synthetic Households

Multiple demographics from STF-3A are used to create the baseline synthetic population. Synthetic households are divided into three categories:

- Family Households – Households with two or more related individuals.
- Nonfamily Households – Individuals living alone or unrelated individuals living together.
- Group Quarters – Dwellings such as college dormitories.

4.5.1 Family Households

Because travel activity can depend on the household type, a baseline synthetic population of households and group quarters is generated for each of the three types. Family households are considered first. The summary tables in STF-3A that concern family households are as follows:

- P24 – Age of the Householder
- P107 – Family Income
- P112 – Number of Workers in the Family
- P124A&B – Poverty Status (which is not used here)
  * Race * Family Type * Presence and Age of Children

Not all categories that are given for the above STF-3A tables are used in the procedure. For example, there are 25 categories of income in table P107. These are collapsed to seven categories. The census STF-3A table P124 (A & B) is used to create a race by using a family class summary table. Data in the categories of (1) below the poverty level and (2) above the poverty level were added to give the resulting 12 family types:

Married Couple	Children under age 5 only
Married Couple	All children between 5 and 17
Married Couple	Children under 5 and 5 to 17
Married Couple	No children under 18
Male Householder	No wife present; children under age 5 only
Male Householder	No wife present; all children between 5 and 17
Male Householder	No wife present; children under 5 and 5 to 17
Male Householder	No wife present; no children under 18
Female Householder	No husband present; children under age 5 only
Female Householder	No husband present; all children between 5 and 17
Female Householder	No husband present; children under 5 and 5 to 17
Female Householder	No husband present; no children under 18

4.5.2 Nonfamily Households

Summary tables in STF-3A for nonfamily households are as follows:

- P17 – Household Type and Relationship
- P20 – Race ∗ Household Type ∗ Presence and Age of Children
  (The race of nonfamily householders can be derived from this table.)
- P24 – Age of Nonfamily Householder
- P110 – Nonfamily Household Income
- P127 – Poverty Status (not used here) ∗ Age of Householder ∗ Household Type

4.5.3 Group Quarters

There are only two summary tables for group quarters in STF-3A:

- P40 – Group Quarters
- P41 – Group Quarters * Age

4.6 Adjusting the IPF Routine

Minor adjustments must be made to the IPF routine to handle marginal summaries in table form. For example, two-way marginals (such as the race * family class table given Section 1.2.4) are considered to be one marginal by the IPF routine. Such marginal tables are converted to a single demographic whose categories consist of all the combinations of the two demographics involved.

If two marginal tables contain a common demographic variable (e.g., the alone/not alone demographic in tables P17 and P127), the procedure is not altered and the fitting proceeds as above, treating each marginal separately.

In cases in which one demographic variable is in two summary tables (a one-dimensional table and a two-dimensional table) and has fewer categories in the two-dimensional table (e.g., STF-3A summary tables P24 and P127), an additional step is required. The procedure uses only one marginal table at a time. When the table with the *collapsed* marginal is considered, the procedure updates the cells as usual where all of the cells that contribute to the individual collapsed categories are updated by the same proportion.

4.7 Locating and Numbering the Population; Assigning Vehicle Emissions Type

The baseline synthetic population is produced on a block-group basis—no other information about the location of individual households is known. To place each household on the transportation network, procedures are developed using land-use data. The number of vehicles owned by each household is given in the PUMS and is, therefore, in the synthetic population.

The Emissions Estimator module, which is described in Chapter 5, requires that the vehicles be identified by emissions type. However, the emissions type of the vehicles in the household is unknown. The Population Synthesizer contains a model to assign vehicle types to each vehicle in the population. The last step in the creation of the synthetic population is to assign a unique number to each household and each person in the population.

4.7.1 Activity Location

Each household in the population is located at an activity location in the TRANSIMS Network. These are usually on the *walk* portion of the network.

Each network is required to have an *Activity Location* file. This file contains the locations of those places on the network in which activities may take place. Associated with these locations is a set of land-use characteristics that indicate the type of activities that may take place at that location.

Each network has a unique set of land-use characteristics associated with its activity locations. Land use is used to form a weighting factor for each activity location that represents the relative likelihood of a housing unit being placed there. The exact formulation of these weights depends on the network under investigation and the availability of land-use information. For a network representing a real metropolitan area, the land use could, for example, contain the square footage of single-family residential housing along with the square footage of multifamily housing that surrounds the activity location.

In this case, the weights for the activity locations could be formed by adding the square footage of single-family residential housing to a multiple of the square footage of multifamily housing (e.g., 10).

4.7.1.1 Placing Households on Activity Locations

Given the housing weights associated with each activity location on the network, households are placed on these locations by taking the steps outlined below.

Step One

- Identify all activity locations within a block group.
- Assume that there are n of them.
- Denote the associated household weights for these activities by w_i.
- Compute the probabilities as follows: $p_i = w_i / S w_i$

Step Two

- Assign each individual household in the block group to one of the n activity locations according to the probabilities, p_i
- The location of the households is one of the required demographics for each synthetic household.

4.7.2 Vehicles and Their Emissions

Each synthetic household is created with a number of vehicles assigned to it. These vehicles have a unique number and are identified as belonging to the household.

Assigned to each vehicle in the population is one of the vehicle emission types, which are described in Chapter Seven of this volume. This assignment may be done at random according to either a national or local distribution of vehicle emission types.

Each vehicle is also assigned a starting location, which consists of one of the parking locations on the driving network. Traditionally, this location has been the parking location closest to the household location. This information is written to the vehicle file.

4.7.3 Assigning Identification Numbers

The final step in generating a synthetic population is to assign a unique number to each household and person in the population. The person number is a unique identifier carried through the Route Planner to the Traffic Microsimulator. All output that is person-oriented references these numbers.

Each vehicle driver in TRANSIMS must have an entry in the synthetic population. Therefore, fictitious individuals are added to the population to represent those who travel on the network but do not live in the area undergoing study. Known as "itinerant travelers," these are added to the synthetic population as single-person households, each with one vehicle. The same is true for transit drivers and freight haulers.

These households, along with the individual, are given their own unique household and person number. If demographics are added to the actual synthetic persons or households, the same demographics must be added to the itinerant traveler population. In some cases, these may be meaningless numbers because the activity list for these travelers is generated from origin-destination tables independent of the individual's demographics.

In equity studies, itinerant travelers can be viewed as a separate population. Every itinerant traveler owns one vehicle. The vehicle is given a unique number and type and is placed in the vehicle file. The starting location of these vehicles is the parking location where the traveler's trip begins. These starting points are most likely on the boundary of the study area, as itinerant travelers are those that are passing through the area or entering the area from the outside.

5. USING THE POPULATION SYNTHESIZER

5.1 Overview

The Population Synthesizer module contains several programs that are executed in order. The module prepares files used by the subsequent modules.

5.2 Assembling the Required Input Data to Generate a Synthetic Population

- Sample input data are supplied with the TRANSIMS-1.1 software in *TRANSIMS_HOME/data/synpop*. You may use these data or go through the general procedure described here to obtain similar data. Be aware that the population data must correspond with the supplied transportation network data to complete subsequent tasks in the TRANSIMS analysis process. Use the general procedure advisedly.
- PUMS and STF-3A data are available on CD-ROM from the Census Bureau.
- MABLE/Geocorr data are obtained from the following Internet site: http://plue.sedac.ciesin.org/plue/geocorr/ .
- A file containing the marginal distributions of household size, householder age, and household income as a function of block group must be created or obtained if a population is to be forecasted.

5.2.1 Obtaining MABLE/Geocorr Data

Before running the Population Synthesizer, obtain the MABLE/Geocorr data from an Internet browser. Perform the following steps to generate a MABLE data file:

Step One Go to the MABLE/Geocorr web site and select a state.

Step Two Select the source and destination Geocode data (see Fig. 5 and Fig. 6).

Step Three For weighting variable, select Population (1900 Census). Do **not** check the box *Ignore Census Blocks* (see Fig. 7).

Step Four Select Comma Separated Value File→Codes and Names (see Fig. 8). No additional output options are required.

Step Five Click [Run Request]. The web server will require several minutes to generate the file. When it is finished, a page with a *geocorr.csv* link will be displayed.

Step Six Click on the link to view the MABLE data.

Step Seven After the data have downloaded, use your browser's *Save File* feature to save the data to disk. It is advisable to save the file with a meaningful name, such as *NewMexico_MABLE.csv.* The file name extension must be *.csv*.

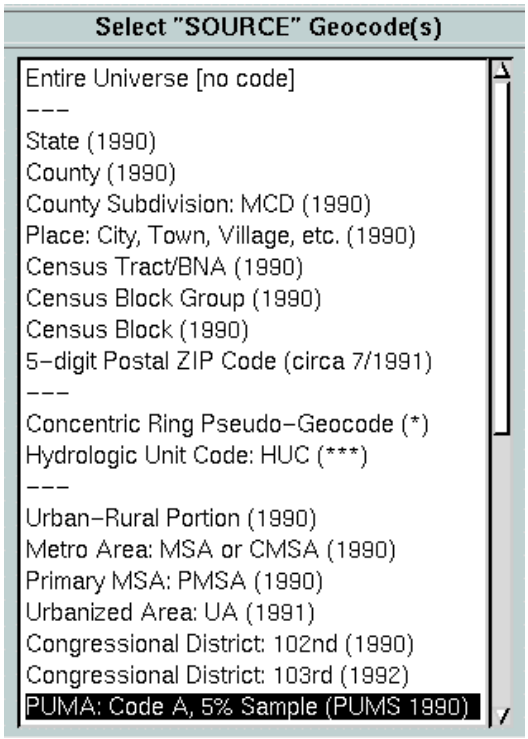

Fig. 5. The Select "SOURCE" Geocode(s) window.

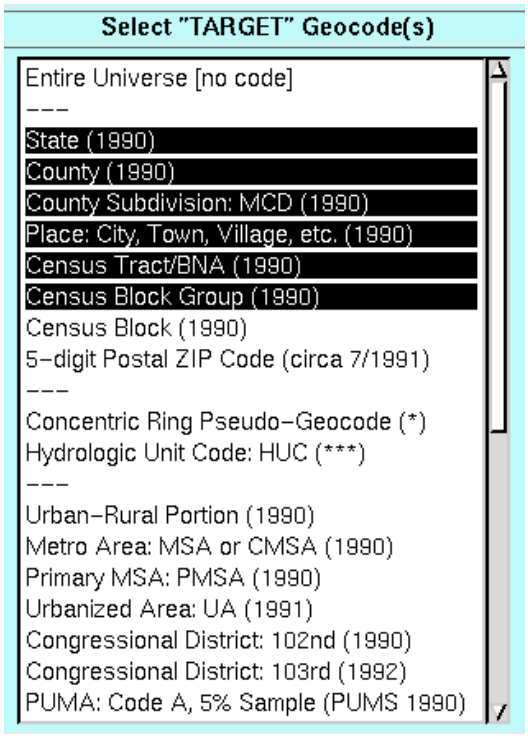

Fig. 6. The Select "TARGET" Geocode(s) window.

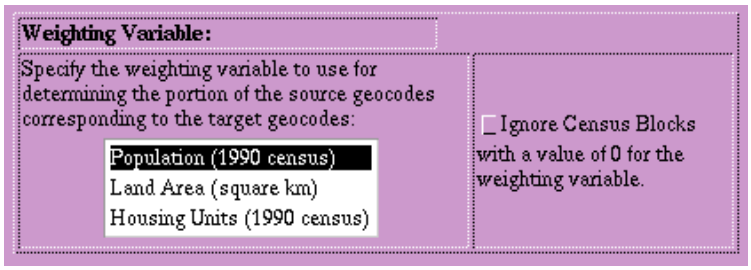

Fig. 7. The Weighting Variable window.

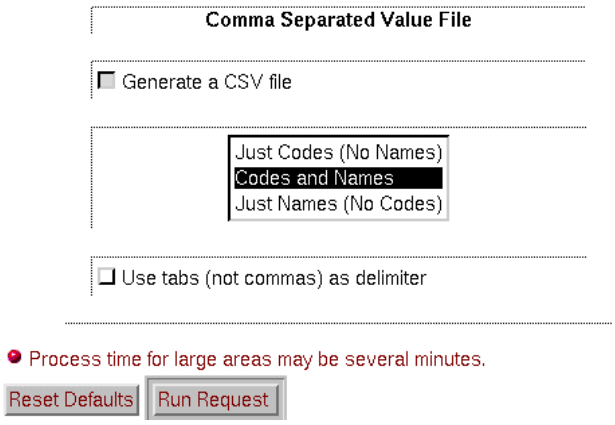

Fig. 8. The Comma-Separated Value File window.

5.3 Running the Population Synthesizer

To run the Population Synthesizer, use the following command line:

```
% Syn example.config
```

where `example.config` is the configuration file to be used. Appendix A provides an explanation of the configuration file keys.

5.3.1 Multiple PUMS

Although the Population Synthesizer will process multiple PUMS in a single run, we advise running it separately for each PUMS of interest. Some of the correlation structure within PUMS records is lost when PUMS are processed together.

5.3.2 Memory Load

The iterative proportional fitting computational process requires a fairly large amount of memory. The Population Synthesizer was run on PUMAS 01000, 01200, 01300, 01400, and 01500 for urban area 6442 (Portland—Vancouver, OR—WA (pt.): FIPS.STATE=41, URBAREA=6442); the running process required 110.6 MB of memory at its peak usage. For this reason, it is advisable to run one PUMA at a time for areas of interest.

The synthetic population output files are large as well. For the above-mentioned case,

- the family synthetic population file was 67.4 MB,
- the non-family file was 13.2 MB, and
- the group quarters file was 0.9 MB.

The processing time for this set of PUMAs was approximately four hours from start to finish, again on a 266 MHz Pentium machine running Linux.

Following the execution of the Population Synthesizer to produce three output files, these three files can be concatenated into a single file before locating the population and assigning household and person IDs using the *BlockGroupLoc* computer program. Use a text editor to remove the two header lines from the second and third files, then append each file to the first file. The resulting concatenated file will be used as an input file for the *BlockGroupLoc* program. The *Vehgen* program described in the following section and the Activity Generator use the located population file produced by *BlockGroupLoc*.

5.4 Locating a Population on a Transportation Network

A computer program, *BlockGroupLoc*, generates home locations for populations on a transportation network by correlating census tract and block group user data values specified in the network activity location file with tract and block group data in the baseline population. Candidate home locations must have the same census tract and block group as the household; they also must have residential land-use values greater than zero.

Some households may be in block groups that do not have any activity locations on the transportation network that are associated with that block group. Alternative tract and block groups may be specified for these households. The alternative tract/block group pairs are specified in a Tract/Block Group Substitution file.

BlockGroupLoc also generates household and person IDs and assigns them to the located population. The user data in the activity location table in the TRANSIMS transportation network must contain tract, block group, and residential and commercial land use values.

Usage:

```
BlockGroupLoc <configuration file>
```

BlockGroupLoc uses configuration file keys from the TRANSIMS configuration file. Some keys have default values that may be used if the key is not specified in the configuration file. Appendix B lists these configuration file keys.

5.5 Generating a TRANSIMS Vehicle File for Located Synthetic Populations

A TRANSIMS vehicle file contains information about the initial locations of a household's vehicles. For most households, the starting location of the vehicle will be the parking location near the household's home location.

Vehgen is a computer program that creates a TRANSIMS vehicle file containing information about the household's vehicles and their starting locations.

Each vehicle's starting parking location is found by iterating through the process links connected to the home activity location. Every home activity location must have at least one parking location accessible via the activity location's process links.

Usage:

```
Vehgen <configuration file>
```

6. FILES

6.1 Population File

As already discussed, the TRANSIMS baseline synthetic population system is designed to produce three principal types of populations: family households, non-family households, and group quarters. These populations are statistically equivalent to actual populations when compared at the level of block group or higher. In the forecast population, the family, non-family, and group quarters distinction is not made. The synthetic population file contains two header lines followed by the data lines.

6.1.1 Header Lines

- The first line of the file contains the names of the household demographics in the population.
- The second line of the file contains the names of the person demographics in the population.

6.1.1.1 Format

The format of the lines is as follows:

```
<text>: <description demog/data1> ... <description demog/dataN>
```

The `<text>` entry may be any text comment that is meaningful to the user. The `<text>` entry must be followed by a colon (`:`). A single word description of each of the optional household demographics in the file follows the colon.

Each optional household data item present in the household data lines of the file must have a single word description in the household header line (line 1 of the file). Each person demographic that is present in the person data lines of the file must have a single word description in the person demographic line (line 2 of the file). The single word description must not contain white space.

Example:

```
Household Demographics: PUMSHH R18UNDR RWRKR89 RHHINC
Person Demographics: AGE RELAT1 SEX WORK89
```

The household data lines in a file with this header will have four optional household demographic values (`PUMSHH, R18UNDR, RWRKR89,` and `RHHINC`). The individual data lines in a file with this header will have four person demographic values (`AGE, RELAT1, SEX,` and `WORK89`). A complete list of possible demographics is found in Appendix C (*Valid person and household demographic field names*).

6.1.2 Data Lines

For a single synthetic household, the data span multiple lines of the synthetic population file.

Format:

The first line of a household record contains the following household data:

```
<TRACT ID> <Blck Grp ID> H <TRANSIMS HH ID> <# persons> <# vehicles> <Home location> [<HHData1> ... <HHData2>]
```

`<TRACT ID>` and `<Blck Grp ID>` are the census tract and block group numbers. The tract numbers are represented as an integer with the following characteristics:

- Tract number 1 or 1.00 is represented as 000100.
- Tract number 1.01 is represented as 000101.
- The block groups retain their integer value.

The home location is the ID of the home activity location on a TRANSIMS Network. A value of -1 may be used if the home location is not yet known. Every household eventually must be assigned a home location of a TRANSIMS activity location before using TRANSIMS modules.

Following the household data are N lines of person data, where N = number of persons in the household.

```
<TRANSIMS HH ID> P <TRANSIMS Person ID> [PersonDemog1> ... <PersonDemogN>]
```

The household and person demographics/data in the file, both number and type of the data, depend on the demographics used to generate the population.

Example:

Household 1000 has four persons, two autos, home location of 1253, and demographics of `PUMSHH (17643), R18UNDR (1), RWRKR89 (3)`, and `RHHINC (38800)`. Person demographics for each member of the household are `AGE, RELAT1, SEX,` and `WORK89`.

```
Household Demographics: PUMSHH R18UNDR RWRKR89 RHHINC
Person Demographics: AGE RELAT1 SEX WORK89
00001 00002 H 1000 4 2 1253 17643 1 3 38800
1000 P 101 38 0 0 1
1000 P 102 36 1 1 1
1000 P 103 7 2 1 0 104 4 2 1 0
```

6.2 Tract/Block Group Substitution File

Block groups are located at activity locations on a transportation network based on the census tract and block group associated with the activity location in the network Activity

Location Table. When locating a population on a sparse transportation network, some census tract/block groups may not have any associated activity locations.

The Tract/Block Group Substitution File enables users to specify a list of alternate census tract/block group pairs that can be used to identify candidate activity locations where the households in the missing tract/block group can be located.

The Block Group Locator uses the Tract/Block Group Substitution File to identify candidate home locations for households whose tract/block group is not found in any activity location on the transportation network. The home location is selected from the activity locations that match the alternative tract/block pairs that are specified in the file. The TRANSIMS configuration file key, `POP_NEAREST_BG_FILE`, is used to specify the name of the Tract/Block Group Substitution File to the Block Group Locator. The file format contains one header line followed by the data lines.

6.2.1 Header Lines

The first line of the file contains the column header `TRACT` and `BG` followed by `TRACT-1 BG-1 ... TRACT-N BG-N,` where `N` is the number of alternate tract/block groups that will be specified. The fields in the line are white-space delimited.

```
TRACT BG TRACT-1 BG-1 ... TRACT-N BG-N
```

Example:

```
TRACT   BG  TRACT-1 BG-1    TRACT-2 BG-2    TRACT-3 BG-3    TRACT-4 BG-4
```

6.2.2 Data Lines

The data lines in the file have the census tract and block group of the missing tract/bg pair followed by a list of alternate census tract/block group pairs:

```
<tract id> <block group> <alternate tract 1> <alternate block group 1> ... <alternate tract N> <alternate block group N>
```

Example:

```
  1000     6    1000     5    1000     4    1000     7    1000     8
```

Tract 1000, block group 6, is not found in the activity location file. Activity locations from Tract 1000, block group 5, tract 1000, block group 4, tract 1000 block group 7, and tract 1000, block group 8, can be used as candidate home locations for households in tract 1000, block group 6.

6.3 Forecast Marginal File

The file has no header and each line represents a single census block group. The following fields must be present in this order:

TRACT: The census tract number in a decimal format—the tract must be separated from the block group number by a decimal point; leading or trailing zeros are allowed.

BG	The census block group number.
H1	The number of households containing one person.
H2	The number of households containing two people.
H3	The number of households containing three people
H4	The number of households containing four or more people.
A1	The number of households whose head is less than 24 years old or younger.
A2	The number of households whose head is between 25 and 54 years old.
A3	The number of households whose head is between 55 and 64 years old.
A4	The number of households whose head is 65 years old or older.
I1	The number of households with annual income at or below $17,999
I2	The number of households with annual income between $18,000 and $28,999
I3	The number of households with annual income between $29,000 and $40,499
I4	The number of households with annual income at or above $40,500.

These fields can be separated by spaces or tab characters. The sums H1 + H2 + H3 + H4, A1 + A2 + A3 + A4, and I1 + I2 + I3 + I4 should be identical, and there should not be any records where this sum is zero.

Example:

```
13.01 3 382 255 113 109 140 533 61 125 363 226 148 122
13.01 4 494 330 146 141 182 688 79 162 471 292 191 157
13.02 1 258 268 116 126 80 495 66 127 233 179 169 187
13.02 2 318 329 143 155 100 608 81 156 287 220 208 230
13.02 3 178 184 80 87 56 341 45 87 161 123 116 129
13.02 4 198 205 89 97 63 379 50 97 179 137 130 143
14 1 390 333 161 187 58 699 69 245 407 261 203 200
14 2 411 351 170 197 61 737 73 258 429 275 214 211
0014 3 445 379 184 213 66 797 79 279 463 298 231 229
0014.00 4 257 219 106 123 39 460 45 161 267 172 134 132
14.00 5 242 206 100 116 35 434 43 152 252 162 126 124
0015 1 406 498 253 338 60 969 153 313 336 325 300 534
0015 2 295 363 184 246 43 706 111 228 245 236 218 389
0015 3 233 288 146 195 35 559 88 180 194 187 173 308
0016.01 1 224 337 144 161 46 504 126 190 257 193 177 239
0016.01 2 224 337 144 160 48 503 125 189 257 192 177 239
```

6.4 Library Files

Table 9 records synthetic population library files.

Table 9. Synthetic population library files.

Type	File Name	Description
Binary Files	*libTIO.a*	TRANSIMS Interfaces library
Source Files	*synpopio.h*	Defines synthetic population data structures and interface functions
	synpopio.c	Synthetic population interface functions source file

Appendix A: Synthetic Population Configuration File Keys

Configuration File Key	Description
SYNPOP_BASE_DIRECTORY	*$TRANSIMS_HOME*
SYNPOP_BASE_PREFIX	The file name prefix for the base-synthesized population output files. No base-year output will be generated if this key is blank.
SYNPOP_FORECAST_PREFIX	The file name prefix for the forecast-synthesized population output files. No forecast output will be generated if this key is blank.
SYNPOP_HOUSEHOLD_DEMOGRAPHICS	The list of household PUMS fields to be placed in the population output files (separated by semicolons). See the file *$TRANSIMS_HOME/data/synpop/docs/pumsusdd.txt* for a complete of the possible fields.
SYNPOP_KEEP_TEMP_FILES	Whether to retain the working files after the population synthesis is complete (1 = yes, 0 = no).
SYNPOP_MABLE_FILE	The directory in which the MABLE output file is stored.
SYNPOP_MARGINALS_FILE	The location of the Forecast Marginals file.
SYNPOP_PERSON_DEMOGRAPHICS	The list of person PUMS fields to be placed in the population output files (separated by semicolons). See the file *$TRANSIMS_HOME/data/synpop/docs/pumsusdd.txt* for a complete list of the possible fields.
SYNPOP_PUMAS	The list of five-digit PUMA numbers to be processed (separated by semicolons).
SYNPOP_PUMS_DIRECTORY	The directory in which the PUMS data are stored.
SYNPOP_RANDOM_SEED	The random number seed (integer).
SYNPOP_STATE	The two-letter abbreviation (lowercase) of the state of interest.
SYNPOP_STF_DATA_DIRECTORY	The directory in which the STF3A dBase files are located.
SYNPOP_STF_INFO_DIRECTORY	*%TRANSIMS_HOME/data/synpop/Parep2/stf*
SYNPOP_TEMP_DIRECTORY	The directory in which temporary working files will be placed.

Appendix B: *BlockGroupLoc* Configuration File Keys

Configuration File Key	Description
ACT_BLOCKGROUP_HEADER	The user data column header in the network activity location file used to specify the block group. Default = BG
ACT_HOME_HEADER	The user data column header in the network activity location file used to specify single family home locations. Default = HOME
ACT_MULTI_FAMILY_HEADER	The user data column header in the network activity location file used to specify multifamily home locations. If not specified, multifamily user data from the activity location file is ignored.
ACT_TRACT_HEADER	The user data column header in the network activity location file used to specify the census tract. Default = TRACT
NET_ACTIVITY_LOCATION_TABLE*	The network activity location table name.
NET_DIRECTORY*	The directory where the network files reside.
NET_LINK_TABLE*	The network link table name.
NET_NODE_TABLE*	The network node table name.
POP_BASELINE_FILE*	The name of the file containing the baseline population.
POP_LOCATED_FILE*	The name of the file where the located population will be written.
POP_NEAREST_BG_FILE	The name of the Tract/Block Group Substitution file that contains information about the nearest tract/block group for block groups that have no activity locations on the transportation network.
POP_STARTING_HH_ID	The number from which the generated households will be sequentially numbered. Default = 1
POP_STARTING_PERSON_ID	The number from which the generated persons will be sequentially numbered. Default = 101

* Configuration file keys required for *BlockGroupLoc*. All others are optional and will use default values.

Appendix C: Valid Person and Household Demographic Field Names

Following is a list of the demographic options that are available for households and the allowed values for each demographic item.

```
DATA          SIZE         BEGIN

D  RECTYPE          1            1
        Record Type
V         H  .Housing Record

D  SERIALNO         7            2
V 0000000..
    9999999  .Housing unit/GQ person serial number unique
             .identifier assigned within state or state group

D  SAMPLE           1             9
        Sample Identifier
V         1  .5% sample
V         2  .1% sample
V         3  .Elderly

D  DIVISION         1            10
        Division code
V         0  .Region/division not identifiable
V            .(Selected MSA/PMSAs on 1% sample)
V         1  .New England (Northeast region)
V         2  .Middle Atlantic (Northeast region)
V         3  .East North Central (Midwest region)
V         4  .West North Central (Midwest region)
V         5  .South Atlantic (South region)
V         6  .East South Central (South region)
V         7  .West South Central (South Region)
V         8  .Mountain (West region)
V         9  .Pacific (West region)

D  STATE            2            11
        State Code
V    01..56  .FIPS state code (See appendix I-59)
V        99  .PUMA boundaries cross state lines – 1% file

D  PUMA              5           13
        Public use microdata area (state dependent)
V   00100..
V     99999  .PUMA code (Includes tract groups) 1st 3
V            .Digits = main PUMA – generally county place
V            .Last 2 digits = groups of tracts, BNA, etc.

D  AREATYPE         2            18
        Area type revised for PUMS equivalency file
         (See Appendix C-1)
V        10  .Central city
V        11  .Central city part
V        20  .MSA/PMSA – Outside central city
V        21  .MSA/PMSA – Outside central city (part)
V        22  .Central City (part) & outside central city
V            .(part)
V        30  .Entire MSA
```

```
V        31  .2 or more MSAs/PMSAs
V        40  .Mixed MSA/PMSA/NON-MSA/PMSA area
V        50  .Outside MSA/PMSA
V        60  .Place
V        61  .Place – part
V        70  .MCDs/Towns (New England only)
V        80  .Counties/independent Cities (2 or more)
V        81  .County/independent city – part
V        82  .County/independent city

D  MSAPMSA          4            20
       MSA/PMSA
V    0040..
V      9360  .FIPS/MSA/PMSA code, selected MSA/PMSA
V            .(See appendix G)
V      9997  .Mixed MSA/PMSA NONMSA/PMSA area
V      9998  .2 or more MSAs
V      9999  .Not in MA

D  PSA              3            24
       Planning service area (elderly sample only –
        state dependent)
V      000  .N/A (Elderly PUMS only)
V  1..18B  .Planning service area codes (See appendix G)

D  SUBSAMPL         2            27
       Subsample number (Use to pull extracts – 1/1000/etc.)
V    00..99  .See text. pp 4-45.

D  HOUSWGT          4            29
       Housing Weight
V    0000..
V      1152  .Integer weight of housing unit

D  PERSONS          2            33
       Number of person records following this housing
        record
V       00  .Vacant unit
V       01  .One person record (one person in household
V           .or any person in group quarters)
V    02..29  .Number of person records (number of persons
V           .in household)

D  GQINST           1            35
       Group quarters institution
V        0  .N/A (housing unit)
V        1  .Institutionalized
V        2  .Not institutionalized

D  HFILLER          3            36
       Filler

D  UNITS1           2            39
       Units in structure
V       00  .N/A (GQ)
V       01  .Mobile home or trailer
V       02  .One-family house detached
V       03  .One-family house attached
V       04  .2 Apartments
V       05  .3-4 Apartments
V       06  .5-9 Apartments
V       07  .10-19 Apartments
V       08  .20-49 Apartments
```

```
V        09  .50 or more apartments
V        10  .Other

D  HUSFLAG          1           41
        All 100% housing unit data substituted
V         0  .No
V         1  .Yes

D  PDSFLAG          1           42
        All 100% person data substituted
V         0  .No
V         1  .Yes

D  ROOMS            1           43
        Rooms
V         0  .N/A (GQ)
V         1  .1 Room
V         2  .2 Rooms
V         3  .3 Rooms
V         4  .4 Rooms
V         5  .5 Rooms
V         6  .6 Rooms
V         7  .7 Rooms
V         8  .8 Rooms
V         9  .9 or more rooms

D  TENURE           1           44
        Tenure
V              0  .N/A (GQ/vacant)
V         1  .Owned with mortgage or loan
V         2  .Owned free and clear
V         3  .Rented for cash rent
V         4  .No cash rent

D  ACRE10           1           45
        On ten acres or more
V         0  .N/A (GQ/not a one-family house or mobile home)
V         1  .House on ten or more acres
V         2  .House on less than ten acres

D  COMMUSE          1           46
        Business or medical office on property
V         0  .N/A (GQ/not a one-family house or mobile home)
          1  .Yes
V         2  .No

D  VALUE            2           47
        Property value
V        00  .N/A (GQ/rental unit/vacant, not for sale only)
V        01  .Less than $ 10000
V        02  .$ 10000 - $ 14999
V        03  .$ 15000 - $ 19999
V        04  .$ 20000 - $ 24999
V        05  .$ 25000 - $ 29999
V        06  .$ 30000 - $ 34999
V        07  .$ 35000 - $ 39999
V        08  .$ 40000 - $ 44999
V        09  .$ 45000 - $ 49999
V        10  .$ 50000 - $ 54999
V        11  .$ 55000 - $ 59999
V        12  .$ 60000 - $ 64999
V        13  .$ 65000 - $ 69999
V        14  .$ 70000 - $ 74999
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V        15  .$ 75000 - $ 79999
V        16  .$ 80000 - $ 89999
V        17  .$ 90000 - $ 99999
V        18  .$100000 - $124999
V        19  .$125000 - $149999
V        20  .$150000 - $174999
V        21  .$175000 - $199999
V        22  .$200000 - $249999
V        23  .$250000 - $299999
V        24  .$300000 - $399999
V        25  .$400000 or more

D  RENT1            2           49
     Monthly rent
V        00  .N/A (GQ/not a rental unit)
V        01  .Less than $ 80
V        02  .$  80 - $ 99
V        03  .$ 100 - $124
V        04  .$ 125 - $149
V        05  .$ 150 - $174
V        06  .$ 175 - $199
V        07  .$ 200 - $224
V        08  .$ 225 - $249
V        09  .$ 250 - $274
V        10  .$ 275 - $299
V        11  .$ 300 - $324
V        12  .$ 325 - $349
V        13  .$ 350 - $374
V        14  .$ 375 - $399
V        15  .$ 400 - $424
V        16  .$ 425 - $449
V        17  .$ 450 - $474
V        18  .$ 475 - $499
V        19  .$ 500 - $524
V        20  .$ 525 - $549
V        21  .$ 550 - $599
V        22  .$ 600 - $649
V        23  .$ 650 - $699
V        24  .$ 700 - $749
V        25  .$ 750 - $999
V        26  .$1000 or more
V        27  .No cash rent (NCR)

D  MEALS            1           51
     Meals included in rent
V         0  .N/A (GQ/not a rental unit/rental-NCR)
V         1  .Yes
V         2  .No

D  VACANCY1         1           52
     Vacant usual home elsewhere (UHE)
V         0  .N/A (occupied or regular vacant/GQ)
V         1  .Vacant UHE-owner
V         2  .Vacant UHE-renter
V         3  .Vacant UHE-undetermined

D  VACANCY2         1           53
     Vacancy status
V         0  .N/A (occupied/GQ)
V         1  .For rent
V         2  .For sale only
V         3  .Rented or sold, not occupied
V         4  .For seasonal/recreational/occasional use
```

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V         5  .For migratory workers
V         6  .Other vacant

D  VACANCY3         1            54
       Boarded up status
V         0  .N/A (occupied/GQ)
V         1  .Yes
V         2  .No

D  VACANCY4         1            55
       Months vacant
V         0  .N/A (occupied/GQ)
V         1  .Less than 1 month
V         2  .1 up to 2 months
V         3  .2 up to 6 months
V         4  .6 up to 12 months
V         5  .12 up to 24 months
V         6  .24 or more months

D  YRMOVED          1            56
       When moved into this house or apartment
V         0  .N/A (GQ/vacant)
V         1  .1989 or 1990
V         2  .1985 to 1988
V         3  .1980 to 1984
V         4  .1970 to 1979
V         5  .1960 to 1969
V         6  .1959 or earlier

D  BEDROOMS         1            57
       Bedrooms
V         0  .N/A (GQ)
V         1  .No bedrooms
V         2  .1 Bedroom
V         3  .2 Bedrooms
V         4  .3 Bedrooms
V         5  .4 Bedrooms
V         6  .5 or more bedrooms

D  PLUMBING         1            58
       Complete plumbing facilities
V         0  .N/A (GQ)
V         1  .Yes, all three facilities
V         2  .No

D  KITCHEN          1            59
         Complete kitchen facilities
V         0  .N/A (GQ)
V         1  .Yes
V         2  .No

D  TELEPHON         1            60
       Telephone in Unit
V         0  .N/A (GQ/vacant)
V         1  .Yes
V         2  .No

D  AUTOS            1            61
       Vehicles (1 ton or less) available
V         0  .N/A (GQ/vacant)
V         1  .No vehicles
V         2  .1 vehicle
V         3  .2 vehicles
```

```
V         4  .3 vehicles
V         5  .4 Vehicles
V         6  .5 Vehicles
V         7  .6 Vehicles
V         8  .7 or more vehicles

D  FUELHEAT         1            62
       House heating fuel
V         0  .N/A (GQ/vacant)
V         1  .Gas:  Underground pipes
V         2  .Gas:  Bottled, tank, or LP
V         3  .Electricity
V         4  .Fuel oil, kerosene, etc.
V         5  .Coal or coke
V         6  .Wood
V         7  .Solar energy
V         8  .Other fuel
V         9  .No fuel used

D  WATER            1            63
       Source of water
V         0  .N/A (GQ)
V         1  .Public system or private company
V         2  .Individual drilled well
V         3  .Individual dug well
V         4  .Other source such as a spring, creek, etc.

D  SEWAGE           1            64
       Sewage disposal
V         0  .N/A (GQ)
V         1  .Public sewer
V         2  .Septic tank or cesspool
V         3  .Other means

D  YRBUILT          1            65
       When structure first built
V         0  .N/A (GQ)
V         1  .1989 or 1990
V         2  .1985 to 1988
V         3  .1980 to 1984
V         4  .1970 to 1979
V         5  .1960 to 1969
V         6  .1950 to 1959
V         7  .1940 to 1949
V         8  .1939 or earlier

D  CONDO            1            66
       House or apartment part of condominium
V         0  .N/A (GQ)
V         1  .Yes
V         2  .No

D  ONEACRE          1            67
       House on less than 1 acre
V         0  .N/A (GQ, two or more units in structure)
V            1  .Yes
V         2  .No

D AGSALES           1            68
       1989 Sales of Agriculture Products
V         0  .N/A (less than 1 acre/GQ/vacant/
V            .2  or more units in structure)
V         1  .None
```

```
V         2  .$1 to $999
V         3  .$1,000 to $2,499
V         4  .$2,500 to $4,999
V         5  .$5,000 to $9,999
V         6  .$10,000 or more

D  ELECCOST         4            69
        Electricity (yearly cost)*
V      0000  .N/A (GQ/vacant)
V      0001  .Included in rent or in condo fee
V      0002  .No charge or electricity not used
V    0003..
       3099  .$3 to $3,099
V      3100  .Topcode
V     3101+  .$3101 or more = state median of topcoded
              .values

D  GASCOST          4            73
        Gas (yearly cost)*
V      0000  .N/A (GQ/vacant)
V      0001  .Included in rent or in condo fee
V      0002  .No charge or gas not used
V    0003..
       2099  .$3 to $2,099
V      2100  .Topcode
V     2101+  .$2101 or more = state median of topcoded
              .values

D  WATRCOST         4            77
        Water (yearly cost)
V       000  .N/A (GQ/vacant)
V       001  .Included in rent or in condo fee
V       002  .No charge
V  003..999  .$3 to $999
V      1000  .Topcode
V     1000+  .$1001+ or more = state median of topcoded
              .values

D  FUELCOST         4            81
        House heating fuel (yearly cost)
V      0000  .N/A (GQ/vacant)
V      0001  .Included in rent or in condo fee
V      0002  .No charge or these fuels not used
V    0003..
       1899  .$3 to $1,899
V      1900  .Topcode
V    1,901+  .$1,901 or more = state median of topcoded
              .value

D  RTAXAMT          2            85
        Property taxes (yearly amount)
V        00  .N/A (GQ/vacant/not owned or being bought/not a
             .one-family house, mobile home or trailer or
             .condo)
V        01  .None
V        02  .$   2 - $  49
V        03  .$  50 - $  99
V        04  .$ 100 - $ 149
V        05  .$ 150 - $ 199
V        06  .$ 200 - $ 249
V        07  .$ 250 - $ 299
V        08  .$ 300 - $ 349
V        09  .$ 350 - $ 399
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V        10  .$ 400 - $ 449
V        11  .$ 450 - $ 499
V        12  .$ 500 - $ 549
V        13  .$ 550 - $ 599
V        14  .$ 600 - $ 649
V        15  .$ 650 - $ 699
V        16  .$ 700 - $ 749
V        17  .$ 750 - $ 799
V        18  .$ 800 - $ 849
V        19  .$ 850 - $ 899
V        20  .$ 900 - $ 949
V        21  .$ 950 - $ 999
V        22  .$1000 - $1099
V        23  .$1100 - $1199
V        24  .$1200 - $1299
V        25  .$1300 - $1399
V        26  .$1400 - $1499
V        27  .$1500 - $1599
V        28  .$1600 - $1699
V        29  .$1700 - $1799
V        30  .$1800 - $1899
V        31  .$1900 - $1999
V        32  .$2000 - $2099
V        33  .$2100 - $2199
V        34  .$2200 - $2299
V        35  .$2300 - $2399
V        36  .$2400 - $2499
V        37  .$2500 - $2599
V        38  .$2600 - $2699
V        39  .$2700 - $2799
V        40  .$2800 - $2899
V        41  .$2900 - $2999
V        42  .$3000 - $3099
V        43  .$3100 - $3199
V        44  .$3200 - $3299
V        45  .$3300 - $3399
V        46  .$3400 - $3499
V        47  .$3500 - $3599
V        48  .$3600 - $3699
V        49  .$3700 - $3799
V        50  .$3800 - $3899
V        51  .$3900 - $3999
V        52  .$4000 - $4099
V        53  .$4100 - $4199
V        54  .$4200 - $4299
V        55  .$4300 - $4399
V        56  .$4400 - $4499
V        57  .$4500 = Topcode
V        58  .$4501 - $54992Ä¿RANGE
V        59  .$5500 - $7499  ³ FOR
V        60  .$7500 or more2ÄÙ  MEDIAN

D  HFILLER2         3           87

D  INSAMT           4           90
        Fire/hazard/flood insurance (yearly amount)
V      0000  .N/A (not owned or being bought/not a one
V            .family house, mobile home, or condo/GQ/vacant)
V      0001  .None
V    0002..
       1299  .$2 to $1,299
V      1300  .Topcode
V     1301+  .$1,301 or more=state median of topcoded values
```

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D  MORTGAG          1            94
        Mortgage status
V         O  .N/A (not owned or being bought/not a one family
             .house, mobile home, or condo/GQ/vacant)
V         1  .Mortgage deed of trust, or similar debt
V         2  .Contract to purchase
V         3  .None

D  MORTGAG3         5            95
          Mortgage payment (monthly amount)
V     00000  .N/A (not owned or being bought/not a one
             .family house, mobile home, or condo/GQ/vacant)
V     00001  .No regular payment required
V   00002..
      01999  .$2 to $1,999
V     02000  .Topcode
V     02001+ . $2,001 or more = state median of topcoded
             .values

D  TAXINCL          1            100
        Payment include real estate taxes
V         0  .N/A (GQ/vacant/not owned or being bought/
             .not a one family house or condo/not mortgaged/
             .No regular mortgage payment)
V         1  .Yes, taxes included in payment
V         2  .No, taxes paid separately or taxes not required

D  INSINCL          1            101
        Payment include fire/hazard/flood insurance
V         0  .N/A (GQ/vacant/not owned or being bought/
             .Not a one family house, MHT or condo/not
             .mortgaged/no regular mortgage payment)
V         1  .Yes, insurance included in payment
V         2  .No, insurance paid separately or no insurance

D  MORTGAG2         1            102
        Second mortgage or home equity loan status
V         0  .N/A (GQ/vacant/not owned or being bought/
             .not a one family house, mobile home, trailer or
             .condo/not mortgaged/no second mortgage)
V         1  .Yes
V         2  .No

D  MORTAMT2         5            103
        Second mortgage payment (monthly amount)
V      00000 .N/A (GQ/vacant/condo/not owned or being
             .bought/not a one family house/not mortgaged/
             .no second mortgage)
V      00001 .No regular payment required
V    00002..
       00999 .$2 to $999
V      01000 .Topcode
V     01001+ .$1001 or more = state median of topcoded
      .values

D  CONDOFEE         4            108
        Condo fee (monthly amount)
V      0000  .N/A (not owned or being bought/not
V            .condo/GQ/vacant/no condo fee)
V    0001..
       0599  .$1 - $599
V      0600  .Topcode
```

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V     0601+  .$601 or more = state median of topcoded values

D  MOBLHOME         4            112
        Mobile home costs (yearly amount)
V      0000  .N/A (GQ/vacant/not owned or being bought/
V            .not mobile home/no costs)
V    0001..
V      3399  .$1 - $3,399 (cost in dollars)
V      3400  .Topcode
V     3401+  .$3401 or more = state median of topcoded
V            .values

D  RFARM            1            116
        Farm/nonfarm status
V         0  .N/A (GQ/urban)
V         1  .Rural farm
V             2  .Rural nonfarm

D  RGRENT           4            117
        Gross rent
V      0000  .N/A (GQ/vacant, not rented for cash rent)
V    0001..
       1499  .Gross rent (dollars)
V      1500  .Topcode
V     1501+  .1501 or more = state median of topcoded values

D  RGRAPI           2            121
        Gross rent as a percentage of household income in
         1989
V        00  .N/A (GQ/vacant/not rented for cash rent/owner
             .occupied/no household income)
V        01  . 1% to  9%
V        02  .10% to 14%
V        03  .15% to 19%
V        04  .20% to 24%
V        05  .25% to 29%
V        06  .30% to 34%
V        07  .35% to 39%
V        08  .40% to 49%
V        09  .50% to 59%
V        10  .60% to 69%
V        11  .70% to 79%
V        12  .80% to 89%
V        13  .90% to 99%
V        14  .100% or more

D  HFILLER3         1            123
        Filler

D       ROWNRCST    5            124
        Selected monthly owner costs
V      00000 .N/A (not owned or being bought/not a one
V            .family house, mobile home, or
V            .condo/GQ/vacant/no costs )
V   00001..
      20299  .Monthly owner costs in dollars
V     20300  .Topcode

D  RNSMOCPI         3            129
        Selected monthly owner costs as a percentage of
         household income in 1989
V       000  .N/A (not owned or being bought/not a one family
             .house, mobile home, or condo/GQ/vacant/no HH
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             .income)
V  001..100  .1% to 100%
V       101  .101% or more

D  RRENTUNT          1            132
        Specified rent unit
V         0  .Not specified rent unit
V         1  .Specified rent unit

D  RVALUNT           1            133
        Specified value unit
V         0  .Not specified value unit
V         1  .Specified value unit

D  RFAMINC           7            134
        Family income
V   0000000  .N/A(GQ/vacant/no income)
V -999999..
V   9999999  .Total family income in dollars (See user notes
             .for state maximum and minimum values
             .Includes single person households.)

D  RHHINC            7            141
        Household income
V   0000000  .N/A(GQ/vacant/no income)
V -999999..
    9999999  .Total household income in dollars (See user notes
             .for state maximum and minimum values)

D  RWRKR89           1            148
        Workers in family in 1989
V         0  .N/A (GQ/vacant/non-family household)
V         1  .No workers
V         2  .1 worker
V         3  .2 workers
V         4  .3 or more workers in family

D  RHHLANG           1            149
        Household language
V         0  .N/A (GQ/vacant)
V         1  .English only
V         2  .Spanish
V         3  .Other Indo-European language
V         4  .Asian or Pacific Island language
V         5  .Other language

D  RLINGISO          1            150
        Linguistic isolation
V         0  .N/A (GQ/vacant)
V         1  .Not linguistically isolated
V         2  .Linguistically isolated

D  RHHFAMTP          2            151
        Household/family type
V        00  .N/A (GQ/vacant)
V        01  .Married-couple family household
V             Other family household:
V        02  .Male householder
V        03  .Female householder
V             Nonfamily household:
V             Male householder:
V        11  .Living alone
V        12  .Not living alone
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V             Female householder:
V        21  .Living alone
V        22  .Not living alone

D  RNATADPT         2           153
        Number of own natural born/adopted children in
         household (unweighted)
V        00  .N/A(GQ/vacant/no own natural born/adopted
V            .children)
V    01..28  .Number of own children natural born/adopted
             .children in household

D  RSTPCHLD         2           155
        Number of own stepchildren in household (unweighted)
V        00  .N/A(GQ/vacant/no own stepchildren)
V    01..28  .Number of own stepchildren in household

D  RFAMPERS         2           157
        Number of persons in family (unweighted)
V        00  .N/A (GQ/vacant/non-family household)
V    01..29  .Number of persons in family

D  RNRLCHLD*        2           159
        Number of related children in household (unweighted)
V        00  .N/A (GQ/vacant/no related children)
V    01..28  .Number of related children in household

D  RNONREL          1           161
          Presence of nonrelatives in household
V         0  .N/A (No nonrelatives in household/GQ/vacant)
V         1  .1 or more nonrelatives in household

D  R18UNDR          1           162
        Presence of person under 18 years in household
V         0  .N/A (No person under 18 in household/GQ/vacant)
V         1  .1 or more person under 18 in household

D  R60OVER          1           163
        Presence of persons 60 years and over in household
V         0  .N/A (No person 60 and over/GQ/vacant)
V         1  .1 person 60 and over (unweighted)
V         2  .2 or more person 60 and over (unweighted)

D  R65OVER          1           164
        Presence of person 65 years and over in household
V         0  .N/A (No person 65 and over/GQ/vacant)
V         1  .1 person 65 and over (unweighted)
V         2  .2 or more person 65 and over (unweighted)

D  RSUBFAM          1           165
        Presence of subfamilies in Household
V         0  .N/A (No subfamilies or not
V            .applicable/GQ/vacant)
V         1  .1 or more subfamilies

D  AUNITS1          1           166
        Units in structure allocation
V         0  .No
V         1  .Yes

D  AROOMS           1           167
        Rooms allocation
V         0  .No
```

```
V         1  .Yes

D  ATENURE          1            168
       Tenure allocation
V         0  .No
V         1  .Yes

D  AACRES10         1            169
       On ten acres or more allocation
V         0  .No
V         1  .Yes

D  ACOMMUSE         1            170
       Business or medical office on property allocation
V         0  .No
V         1  .Yes

D  AVALUE           1            171
       Value allocation
V         0  .No
V         1  .Yes

D  ARENT1           1            172
       Monthly rent allocation
V         0  .No
V         1  .Yes

D  AMEALS           1            173
       Meals included in rent allocation
V         0  .No
V         1  .Yes

D  AVACNCY2         1            174
       Vacancy status allocation
V              0  .No
V         1  .Yes

D  AVACNCY3         1            175
       Boarded up status allocation
V         0  .No
V         1  .Yes

D  AVACNCY4         1            176
       Months vacant allocation
V         0  .No
V         1  .Yes

D  AYRMOVED         1            177
       When moved into this house or apartment allocation
V         0  .No
V         1  .Yes

D  ABEDROOM         1            178
       Number of bedrooms allocation
V         0  .No
V         1  .Yes

D  APLUMBNG         1            179
       Complete plumbing facilities allocation
V         0  .No
V         1  .Yes

D  AKITCHEN         1            180
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        Complete kitchen facilities allocation
V         0  .No
V         1  .Yes

D  APHONE           1            181
        Telephones in house allocation
V         0  .No
V         1  .Yes

D  AVEHICLE         1            182
        Vehicles available by household allocation
V         0  .No
V         1  .Yes

D  AFUEL            1            183
        House heating fuel allocation
V         0  .No
V         1  .Yes

D  AWATER           1            184
        Source of water allocation
V         0  .No
V         1  .Yes

D  ASEWER           1            185
        Sewage disposal allocation
V         0  .No
V         1  .Yes

D  AYRBUILT         1            186
        When structure first built allocation
V         0  .No
V         1  .Yes from not answered
V         2  .Yes “don’t know”

D  ACONDO           1            187
        House or apartment part of condominium allocation
V         0  .No
V         1  .Yes

D  AONEACRE         1            188
        House on less than 1 acre allocation
V         0  .No
V         1  .Yes

D  AAGSALES         1            189
        1989 Sales of Agricultural Products allocation
V         0  .No
V         1  .Yes

D  AELECCST         1            190
        Electricity (yearly cost) allocation
V         0  .No
V         1  .Yes


D  AGASCST          1            191
        Gas (yearly cost) allocation
V         0  .No
V         1  .Yes

D  AWATRCST         1            192
        Water (yearly cost) allocation
```

```
V         0  .No
V         1  .Yes

D  AFUELCST*        1            193
        House heating fuel (yearly cost) allocation
V         0  .No
V         1  .Yes

D  ATAXAMT          1            194
        Taxes on property allocation
V         0  .No
V         1  .Yes

D  AINSAMT          1            195
        Fire, hazard, flood insurance allocation
V         0  .No
V         1  .Yes

D  AMORTG           1            196
        Mortgage status allocation
V       0 .No
V       1 .Yes no answer
V       2 .Yes from junior mortgage

D  AMORTG3          1            197
        Regular mortgage payment allocation
V       0 .No
V       1 .Yes

D  ATAXINCL         1            198
        Payment include real estate taxes allocation
V       0 .No
V       1 .Yes

D  AINSINCL         1            199
        Payment include fire, hazard, flood insurance
         allocation
V       0 .No
V       1 .Yes

D  AMORTG2          1            200
        Second mortgage status allocation
V       0 .No
V       1 .Yes

D  AMRTAMT2         1            201
             Second mortgage payment allocation
V       0 .NO
V       1 .Yes

D  ACNDOFEE         1            202
        Condominium fee allocation
V       0 .No
V       1 .Yes

D  AMOBLHME         1            203
        Mobile home costs allocation
V       0 .No
V       1 .Yes

D  FILLER           28           204
```

```
Following is a list of the demographic options that are available for persons
and the allowed values for each demographic item.

DATA                    SIZE     BEGIN

D  RECTYPE          1            1
        Record Type
V          P .Person Record

D  SERIALNO         7            2
V  0000000..
V    9999999 .Housing unit/GQ person serial number unique
V            .identifier assigned within state or state group

D  RELAT1           2            9
        Relationship
V         00 .Householder
V         01 .Husband/wife
V         02 .Son/daughter
V         03 .Stepson/stepdaughter
V         04 .Brother/sister
V         05 .Father/mother
V         06 .Grandchild
V         07 .Other relative
                Not related
V         08 .Roomer/boarder/foster child
V         09 .Housemate/roommate
V         10 .Unmarried partner
V         11 .Other nonrelative
                Group quarters
V         12 .Institutionalized person
V         13 .Other persons in group quarters

D  SEX              1           11
        Sex
V          0 .Male
V          1 .Female

D  RACE             3           12
        Recoded detailed race code (Appendix C)
V    001-037 .(See appendix C)
V    301-327 .American Indian Tribes

D  AGE              2           15
        Age
V         00 .Less than 1 year
V     01..89 .Age in years
V         90 .90 or more years old

D  MARITAL          1           17
        Marital status
V          0 .Now married, except separated
V          1 .Widowed
V          2 .Divorced
V          3 .Separated
V          4 .Never married or under 15 years old

D  PWGT1            4           18
        Person's weight
V     0001..
V       1152 .Person's weight

D  PFILLER1         4           22
```

```
        Filler

D  REMPLPAR         3            26
        Employment status of parents
V        000 .N/A (not own child of householder, and not
             .child in subfamily)
V           Living with two parents:
V             Both parents in labor force:
V       111     .Both parents at work 35 or more hours
V       112     .Father only at work 35 or more hours
V       113     .Mother only at work 35 or more hours
V       114     .Neither parent at work 35 or more hours
V             Father only in labor force:
V       121     .Father at work 35 or more hours
V       122     .Father not at work 35 or more hours
V             Mother only in labor force:
V       133     .Mother at work 35 or more hours
V       134     .Mother not at work 35 or more hours
V       141   Neither parent in labor force
V           Living with one parent:
V             Living with father:
V       211     .Father at work 35 or more hours
V       212     .Father not at work 35 or more hours
V       213     .Father not in labor force
V             Living with mother:
V       221     .Mother at work 35 or more hours
V       222     .Mother not at work 35 or more hours
V       223     .Mother not in labor force

D  RPOB             2           29
        Place of birth (Recode)
V       10   .Born in State of residence
V           Born in other State in the U.S.:
V       21   .Northeast
V       22   .Midwest
V       23   .South
V       24   .West
V           U.S. outlying areas:
V       31   .Puerto Rico
V       32   .American Samoa
V       33   .Guam
V       34   .Northern Marianas
V       35   .US Virgin Islands
V       36   .Elsewhere
V       40   .Born abroad of American parents
V           Foreign born:
V       51   .Naturalized citizen
V       52   .Not a citizen

D  RSPOUSE          1            31
        Married, spouse present/spouse absent
V        0   .N/A (less than 15 years old)
V        1   .Now married, spouse present
V        2   .Now married, spouse absent
V        3   .Widowed
V        4   .Divorced
V        5   .Separated
V        6   .Never married

D  ROWNCHLD         1            32
           *Own child (see Appendix B, page 14)
V       * 1   .Own child
V       * 0   .Not own child
```

```
D  RAGECHLD         1            33
        Presence and age of own children
V        * 0 .N/A (male)
V          1 .With own children under 6 years only
V          2 .With own children 6 to 17 years only
V          3 .With own children under 6 years and 6 to 17
             .years
V        *  4 .No own children (.incl. females under 16 years)
D  RRELCHLD         1            34

             *Related child (see Appendix B, Page 14)
V         * 1 .Related child
V         * 0 .Not related child

D  RELAT2           1            35
        Detailed relationship (other relative)
V          0 .N/A (GQ/not other relative)
V          1 .Son-in-law/daughter-in-law
V          2 .Father-in-law/mother-in-law
V          3 .Brother-in-law/sister-in-law
V          4 .Nephew/niece
V          5 .Grandparent
V          6 .Uncle/aunt
V          7 .Cousin
V          8 .Other related by blood or marriage
V          9 .Other relative

D  SUBFAM2          1            36
        Subfamily number
V          0 .N/A (GQ/not in a subfamily)
V          1 .In subfamily 1
V          2 .In subfamily 2
V          3 .In subfamily 3

D  SUBFAM1          1            37
        Subfamily relationship
V          0 .N/A (GQ/not in a subfamily)
V          1 .Husband/wife
V          2 .Parent in a parent/child subfamily
V          3 .Child in subfamily

D  HISPANIC         3            38
        Detailed Hispanic origin code (See appendix I)
V  000,006.. .
         199 . Not hispanic
V  001,210..
         220 .Mexican, mex-am
V  002,261..
         270 .Puerto Rican
V  003,271..
         274 .Cuban
V   221..230 .Central American
V   231..249 .South American
V   275..289 .Dominican
V  004,200..
   209,250..
         260
V   290..401 .Other Hispanic

D  POVERTY          3            41
        Person poverty status recode (See appendix B)
V         000 .N/A
```

```
V   001..500 .% Below or above poverty status value
V        501 .501% or more of poverty value

D  POB              3           44
        Place of birth (Appendix I)
V 001..056   .FIPS State code (U.S. States and D.C.)
V 060..099   .Puerto Rico (072) or U.S. outlying area
V 100..553   .Foreign country
V      554   .At sea
V      555   .Abroad, not specified

D  CITIZEN          1           47
        Citizenship
V        0   .Born in the U.S.
V        1   .Born in Puerto Rico, Guam, and outlying areas
V        2   .Born abroad of American parents
V        3   .U.S. citizen by naturalization
V        4   .Not a citizen of the U.S.

D  IMMIGR           2           48
        Year of entry
V       00   .Born in the U.S.
V       01   .1987 to 1990
V       02   .1985 to 1986
V       03   .1982 to 1984
V       04   .1980 or 1981
V       05   .1975 to 1979
V       06   .1970 to 1974
V       07   .1965 to 1969
V       08   .1960 to 1964
V       09   .1950 to 1959
V       10   .Before 1950

D  SCHOOL           1           50
        School enrollment
V        0   .N/A (less than 3 years old)
V        1   .Not attending school
V        2   .Yes, public school, public college
V        3   .Yes, private school, private college

D  YEARSCH          2           51
        Educational attainment
V       00 .N/A (less than 3 years old)
V       01 .No school completed
V       02 .Nursery school
V       03 .Kindergarten
V       04 .1st, 2nd, 3rd, or 4th grade
V       05 .5th, 6th, 7th, or 8th grade
V       06 .9th grade
V       07 .10th grade
V       08 .11th grade
V       09 .12th grade, no diploma
V       10 .High school graduate, diploma or GED
V       11 .Some college, but no degree
V       12 .Associate degree in college, occupational program
V       13 .Associate degree in college, academic program
V       14 .Bachelor's degree
V       15 .Master's degree
V       16 .Professional degree
V       17 .Doctorate degree

D  ANCSTRY1         3           53
        Ancestry – first entry (See appendix I)
```

```
V 001..998   .Ancestry codes – first entry
V      999   .Not reported

D  ANCSTRY2         3            56
        Ancestry – second entry (See appendix I)
V        000 .No secondary ancestry
V   001..998 .Ancestry codes
V        999 .Not reported

D  MOBILITY         1            59
        Mobility status (lived here on April 1, 1985)
V          0 .N/A(less than 5 years old)
V          1 .Yes same house (nonmovers)
V          2 .No, different house (movers)

D  MIGSTATE         2            60
        Migration – State or foreign country code
         (Appendix I)
V         00 .N/A (person less than 5 years old/lived
V            .in same house in 1985)
V    01..56 .FIPS state code (U.S. States and D.C.)
V         72 .Puerto Rico
V         98 .Other abroad in 1985
V         99 .State not identified (B sample)

D  MIGPUMA          5            62
        Migration PUMA (state dependent)
V      00000 .N/A (person less than 5 years old/lived in
             .same house in 1985)
V    00100..
       99800 .Migration PUMA  (Not coded to tract level)
V      99900 .Abroad

D  LANG1            1            67
        Language other than English at home
V          0 .N/A (less than 5 years old)
V          1 .Yes, speaks another language
V          2 .No, speaks only English

D  LANG2            3            68
        Language spoken at home (See appendix I)
V   000..600 .N/A (less than 5 years old/speaks only
             .English)
V   601..999 .Specific language codes

D  ENGLISH          1            71
        Ability to speak English
V          0 .N/A (less than 5 years old/speaks only English)
V          1 .Very well
V          2 .Well
V          3 .Not well
V          4 .Not at all

D  MILITARY         1            72
        Military service
V          0 .N/A (less than 16 years old)
V          1 .Yes, now on active duty
V          2 .Yes, on active duty in past, but not now
V          3 .Yes, service in reserves or national guard only
V          4 .No service

D  RVETSERV         2            73
        Veteran period of service
```

```
V       00   .N/A (less than 16 years old, no active duty)
V       01   .September 1980 or later only
V       02   .May 1975 to August 1980 only
V       03   .May 1975 to August 1980 and September 1980
V            .or later only
V       04   .Vietnam era, no Korean conflict, no WWII
V       05   .Vietnam era and Korean conflict, no WWII
V       06   .Vietnam era and Korean conflict and WWII
V       07   .February 1955 to July 1964 only
V       08   .Korean conflict, no Vietnam era, no WWII
V       09   .Korean conflict and WWII, no Vietnam era
V       10   .WWII, no Korean conflict, no Vietnam era
V       11   .Other service

D  SEPT80           1           75
              Served September 1980 or later
V        0   .(Did not serve this period/less than 16 years
V            .old)
V        1   .Served this period

D  MAY75880         1           76
           Served May 1975 to August 1980
V        0   .(Did not serve this period/less than 16 years
V            .old)
V        1   .Served this period

D  VIETNAM          1           77
           Served Vietnam era (August 1964 – April 1975)
V        0   .(Did not serve this period/less than 16 years
V            . old)
V        1   .Served this period

D  FEB55            1           78
           Served February 1955 – July 1964
V        0   .(Did not serve this period/less than 16 years
V            .old)
V        1   .Served this period

D  KOREAN           1           79
           Served Korean conflict (June 1950 – January 1955)
V        0   .(Did not serve this period/less than 16 years
V            .old)
V        1   .Served this period

D  WWII             1           80
           Served World War II (September 1940 – July 1947)
V        0   .(Did not serve this period/less than 16 years
V            .old)
V        1   .Served this period

D  PFILLER2         1           81
           Filler

D  OTHRSERV         1           82
           Served any other time
V        0   .(Did not serve this period/less than 16 years
V            .old)
V        1   .Served this period

D  YRSSERV          2           83
           Years of active duty military service
V       00   .N/A (less than 16 years/no active duty military
V            .service)
```

```
V       01   .1 Year or less of service
V    02..49  .2 to 49 years of service
V       50   .50 or more years of service

D  DISABL1          1           85
       Work limitation status
V         0 .N/A (less than 16 years, and selected persons in
V           .GQs – See appendix C)
V         1 .Yes, limited in kind or amount of work
V         2 .No, not limited

D  DISABL2          1           86
       Work prevented status
V         0 .N/A(less than 16 years, and selected persons in
V           .GQs – See appendix C)
V         1 .Yes, prevented from working
V         2 .No, not prevented from working

D  MOBILLIM         1           87
       Mobility limitation
V         0 .N/A (less than 15 years/institutionalized
V              .person, and selected persons in GQs –
V           .See appendix C)
V         1 .Yes, has a mobility limitation
V         2 .No, does not have a mobility limitation

D  PERSCARE         1           88
       Personal care limitation
V         0 .N/A (less than 15 years/institutionalized
V           .person, and selected persons in GQs –
V           .See appendix C)
V         1 .Yes, has a personal care limitation
V         2 .No, does not have a personal care limitation

D  FERTIL           2           89
       Number of children ever born
V        00 .N/A (less than 15 years/male)
V        01 .No children
V        02 .1 Child
V        03 .2 Children
V        04 .3 Children
V        05 .4 Children
V        06 .5 Children
V        07 .6 Children
V        08 .7 Children
V        09 .8 Children
V        10 .9 Children
V        11 .10 Children
V        12 .11 Children
V        13 .12 or more children

D  RLABOR           1           91
       Employment status recode
V         0 .N/A (less than 16 years old)
V         1 .Civilian employed, at work
V         2 .Civilian employed, with a job but not at work
V         3 .Unemployed
V         4 .Armed forces, at work
V         5 .Armed forces, with a job but not at work
V         6 .Not in labor force

D  WORKLWK          1           92
       Worked last week
```

```
V          0 .N/A (less than 16 years old/not at work/
V            .unemployed/NILF/Q21A not reported)
V          1 .Worked
V          2 .Did not work

D  HOURS            2            93
        Hours worked last week
V       00   .N/A (less than 16 years old/not at
V            .work/unemployed/NILF)
V    01..98  .1 to 98 hours worked last week
V       99   .99 or more hours worked last week

D  POWSTATE         2            95
        Place of work – state – (Appendix I)
V       00   .N/A (not a worker—not in the labor force,
V            .including persons under 16 years; unemployed;
V            .employed, with a job not at work; Armed Forces,
             .With a job but not at work)
V     01-56  .FIPS state code (U.S. States and D.C.)
V       98   .Abroad
V       99   .State not identified

D  POWPUMA          5            97
        Place of work PUMA (State dependent)
V     00000  .N/A (not a worker—not in the labor force,
V            .including persons under 16 years;
V            .unemployed; employed, with a job but not at
V            .work; Armed Forces, with a job but not at
V            .work)
V  00100..
      99800  .PUMA of work (Not coded to tract level)
V     99900  .Abroad

D  MEANS            2            102
        Means of transportation to work
V       00   .N/A (not a worker—not in the labor force,
V            .including persons under 16 years;  unemployed;
V            .employed, with a job but not at work;  Armed
V            .Forces, with a job but not at work)
V       01   .Car, truck, or van
V       02   .Bus or trolley bus
V       03   .Streetcar or trolley car
V       04   .Subway or elevated
V       05   .Railroad
V       06   .Ferryboat
V       07   .Taxicab
V       08   .Motorcycle
V       09   .Bicycle
V       10   .Walked
V       11   .Worked at home
V       12   .Other method

D  RIDERS           1            104
        Vehicle occupancy
V        0   .N/A (not a worker or worker whose means of
V            .transportation to work was not car, truck,
V            .or van)
V        1   .Drove alone
V        2   .2 People
V        3   .3 People
V        4   .4 People
V        5   .5 People
V        6   .6 People
```

```
V        7   .7 to 9 people
V        8   .10 or more people

D  DEPART           4           105
        Time of departure for work – hour and minute
V       0000 .N/A (not a worker or worker who worked at
             .home)
V     0001..
        2400 .Time (hour and minute of departure for
             .work) (2400 midnight)

D  TRAVTIME         2           109
        Travel time to work
V         00 .N/A (not a worker or worker who worked at home)
V     01..98 .1 to 98 minutes to get to work
V         99 .99 Minutes or more to get to work

D  TMPABSNT         1           111
        Temporary absence from work
V          0 .N/A (less than 16 years old/at work/did not
             .report Q25)
V          1 .Yes, on layoff
V          2 .Yes, on vacation, temporary illness, labor
             .dispute
V          3 .No

D  LOOKING          1           112
        Looking for work
V          0 .N/A (less than 16 years old/at work/did not
             .report Q26A)
V          1 .Yes
V          2 .No

D  AVAIL            1           113
        Available for work
V          0 .N/A (less than 16 years/at work/not looking/
             .Q26A = 0/did not report Q26B)
V          1 .No, already has a job
V          2 .No, temporarily ill
V          3 .No, other reasons (in school, etc.)
V          4 .Yes, could have taken a job

D  YEARWRK          1           114
        Year last worked
V          0 .N/A (less than 16 years old)
V          1 .1990
V          2 .1989
V          3 .1988
V          4 .1985 to 1987
V          5 .1980 to 1984
V          6 .1979 or earlier
V          7  .Never worked

D  INDUSTRY         3           115
        Industry
V        000 .N/A (less than 16 years old/unemployed who
             .never worked/nilf who last worked prior to
             .1985)
V 010..992   .specific industry codes (see appendix I)

D  OCCUP            3           118
        Occupation
V      000   .N/A (less than 16 years old/unemployed who
```

```
             .never worked/nilf who last worked prior to
             .1985)
V 003..909   .specific occupation codes (see appendix I)

D  CLASS            1            121
        Class of worker
V        0   .N/A (less than 16 years old/unemployed who
V            .never worked/NILF who last worked prior to
V            .1985)
V        1   .employee of a private for profit company or
V            .business or of an individual, for wages,
V            .salary, or commissions
V        2   .Employee of a private not-for-profit,
V            .tax-exempt, or charitable organization
V        3   .Local government employee (city, county, etc.)
V        4   .State government employee
V        5   .Federal government employee
V        6   .Self-employed in own not incorporated
V            .business, professional practice, or farm
V        7   .Self-employed in own incorporated
V            .business, professional practice or farm
V        8   .Working without pay in family business or farm
V        9   .Unemployed, last worked in 1984 or earlier

D  WORK89           1            122
        Worked last year (1989)
V        0   .N/A (less than 16 years old)
V        1   .Worked last year
V        2   .Did not work last year

D  WEEK89           2            123
        Weeks worked last year (1989)
V       00   .N/A (less than 16 years old/did not work in
             .1989)
V   01..52   .1 to 52 weeks worked last year

D  HOUR89           2            125
        Usual hours worked per week last year (1989)
V       00   .N/A (less than 16 years old/did not work in
                .1989)
V   01..98   .1 To 98 usual hours
V       99   .99 Or more usual hours

D  REARNING         6            127
        Total person's earnings
V     000000 .N/A (no earnings)
V     -19996 .Loss of $19996 or more
V   -19995..
       283999 .Total person's earnings in dollars
V      284000 .$284000 = Topcode
V    284001+ .State medians included

D  RPINCOME         6            133
        Total person's income (signed)
V    000000   .N/A (no income)
V    -29997   .Loss of $29997 or more
V  -29996..
      400999  .Total person's income in dollars
V     401000  .Topcode of total person's income
V    401001+  .State medians included

D  INCOME1          6            139
        Wages or salary income in 1989
```

```
V    000000  .N/A (less than 16 years old/none)
V  000001..
V    139999  .$1 – 139,999
V    140000  .Topcode
V   140001+  .140001 or more = state median of topcoded
V            .values

D  INCOME2          6            145
          Nonfarm self-employment income in 1989 (signed)
V   000000   .N/A (less than 16 years/none)
V   -09999   .Loss of $9,999 or more
V   -00001..
V     -09998 .Loss $1 to $9,998
V     000001 .Break even or $1
V   000002..
      089999 .$2 To $89999
V     090000 .Topcode
V    090001+ .$90,001 or more = state median of topcoded
             .values

D  INCOME3          6            151
        Farm self-employment income in 1989 (signed)
V     000000 .N/A (less than 16 years/none)
V     -09999 .Loss of $9,999 or more
V  -00001 to
      -09998 .Loss $1 to $9,998
V          1 .Break even or $1
V   000002..
      053999 .$2 To $53999
V     054000 .Topcode
V    054001+ .$54001 or more = state median of
             .topcoded values

D  INCOME4          6            157
        Interest, dividends, and net rental income in 1989 (signed)
V     000000 .N/A (less than 15 years/none)
V     -09999 .Loss of $9,999 or more
V  -00001 to
      -09998 .Loss $1 to $9,998
V          1 .Break even or $1
V   000002..
      039999 .$2 To $39999
V     040000 .Topcode
V    040001+ .$40001 or more = state median of
             .topcoded values
D  INCOME5          5            163
        Social security income in 1989
V      00000 .N/A (less than 15 years/none)
V    00001..
       16999 .$1 to $16999
V      17000 .Topcode
V     17001+ .17001 or more = state median of topcoded
             .values

D  INCOME6          5            168
        Public assistance income in 1989
V      00000 .N/A (less than 15 years/none)
V    00001..
        9999 .$1 To $9999
V      10000 .Topcode
V     10001+ .$10001 or more = state median

D  INCOME7          5            173
```

```
        Retirement income in 1989
V    00000   .N/A (less than 15 years/none)
V    00001..
       29999 .$1 to $29999
V      30000 .Topcode
V     30001+ .$30001 or more = state median of topcoded
             .values

D  INCOME8          5            178
        All other income in 1989
V    00000   .N/A (less than 15 years/none)
V  00001..
     19999   .$1 to $19999
V    20000   .Topcode
V   20001+   .$20,001 or more = state median of topcoded
             .values

D  AAUGMENT         1            183
        Augmented person (see text pp. C-5)
V        0   .No
V        1   .Yes

D  ARELAT1          1            184
        Relationship allocation flag
V        0   .No
V        1   .Yes

D  ASEX             1            185
        Sex allocation flag
V        0   .No
V        1   .Yes

D  ARACE            1            186
        Detailed race allocation flag
V        0   .No
V        1   .Yes

D  AAGE              1           187
        Age allocation flag
V        0   .No
V        1   .Yes

D  AMARITAL         1            188
        Marital status allocation flag
V        0   .No
V        1   .Yes

D  AHISPAN          1            189
        Detailed Hispanic origin allocation flag
V        0   .No
V        1   .Yes
D  ABIRTHPL         1            190
        Place of birth
V        0   .No
V        1   .Yes

D  ACITIZEN         1            191
        Citizenship allocation flag
V        0   .No
V        1   .Yes

D  AIMMIGR          1            192
        Year of entry allocation flag
```

```
V       0 .No
V       1 .Yes

D  ASCHOOL          1            193
        School enrollment allocation flag
V       0 .No
V       1 .Yes

D  AYEARSCH         1            194
        Highest education allocation flag
V          0 .No
V          1 .Yes

D  AANCSTR1         1            195
        First ancestry allocation flag
V          0 .No
V          1 .Yes

D  AANCSTR2         1            196
        Second ancestry allocation flag
V          0 .No
V          1 .Yes

D  AMOBLTY          1            197
        Mobility status allocation flag
V          0 .No
V          1 .Yes

D  AMIGSTATE        1            198
        Migration state allocation flag
V          0 .No
V          1 .Yes

D  ALANG1           1            199
        Language other than English allocation flag
V          0 .No
V          1 .Yes

D  ALANG2           1            200
        Language spoken at home allocation flag
V          0 .No
V          1 .Yes

D  AENGLISH         1            201
        Ability to speak English allocation flag
V          0 .No
V          1 .Yes

D  AVETS1           1            202
        Military service allocation flag
V          0 .No
V          1 .Yes

D  ASERVPER         1            203
        Military periods of service allocation flag
V          0 .No
V          1 .Yes
D  AYRSSERV         1            204
        Years of military service allocation flag
V          0 .No
V          1 .Yes

D  ADISABL1         1            205
```

```
        Work limitation status allocation flag
V        0   .No
V        1   .Yes

D  ADISABL2         1            206
        Work prevention status allocation flag
V        0   .No
V        1   .Yes

D  AMOBLLIM         1            207
        Mobility limitation status allocation flag
V        0   .No
V        1   .Yes

D  APERCARE         1            208
        Personal care limitation status allocation flag
V        0   .No
V        1   .Yes

D  AFERTIL          1            209
        Children ever born allocation flag
V        0   .No
V        1   .Yes

D  ALABOR           1            210
        Employment status recode allocation flag
V        0   .No
V        1   .Yes

D  AHOURS           1            211
        Hours worked last week allocation flag
V        0   .No
V        1   .Yes

D  APOWST           1            212
        Place of work state allocation flag
V        0   .No
V        1   .Yes

D  AMEANS           1            213
        Means of transportation to work allocation flag
V        0   .No
V        1   .Yes

D  ARIDERS          1            214
        Vehicle occupancy allocation flag
V        0   .No
V        1   .Yes

D  ADEPART          1            215
        Time of departure to work allocation flag
V        0   .No
V        1   .Yes

D  ATRAVTME         1            216
        Travel time to work allocation flag
V        0   .No
V        1   .Yes

D  ALSTWRK          1            217
        Year last worked allocation flag
V        0   .No
V        1   .Yes
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D  AINDUSTR         1            218
       Industry allocation flag
V      0 .No
V      1 .Yes

D  AOCCUP           1            219
       Occupation allocation flag
V      0 .No
V      1 .Yes

D  ACLASS           1            220
       Class of worker allocation flag
V         0 .No
V         1 .Yes

D  AWORK89          1            221
       Worked last year allocation flag
V         0 .No
V         1 .Yes

D  AWKS89           1            222
       Weeks worked in 1989 allocation flag
V         0 .No
V         1 .Yes

D  AHOUR89          1            223
       Usual hours worked per week in 1989 allocation flag
V         0 .No
V         1 .Yes

D  AINCOME1          1           224
       Wages and salary income allocation flag
V         0 .No
V         1 .No (derived)
V         2 .Yes

D  AINCOME2         1            225
       Nonfarm self-employment income allocation flag
V         0 .No
V         1 .No (derived)
V         2 .Yes

D  AINCOME3         1            226
       Farm self-employment income allocation flag
V         0 .No
V         1 .No (derived)
V         2 .Yes

D  AINCOME4         1            227
       Interest, dividend, and net rental income allocation flag
V         0 .No
V         1 .No (derived)
V         2 .Yes

D  AINCOME5         1            228
       Social security income allocation flag
V         0 .No
V         1 .No (derived)
V         2 .Yes
D  AINCOME6         1            229
       Public assistance allocation flag
V        0   .No
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V        1   .No (derived)
V        2   .Yes

D  AINCOME7         1            230
        Retirement income allocation flag
V        0   .No
V           1   .No (derived)
V        2   .Yes

D  AINCOME8         1            231
        All other income allocation flag
V        0   .No
V        1   .No (derived)

V        2   .Yes
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